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THE MALAYAN AGRICULTURAL JOURNAL

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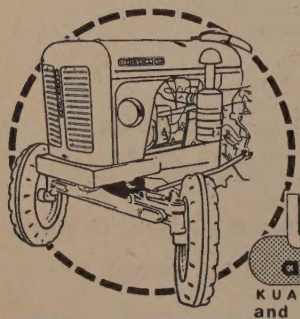

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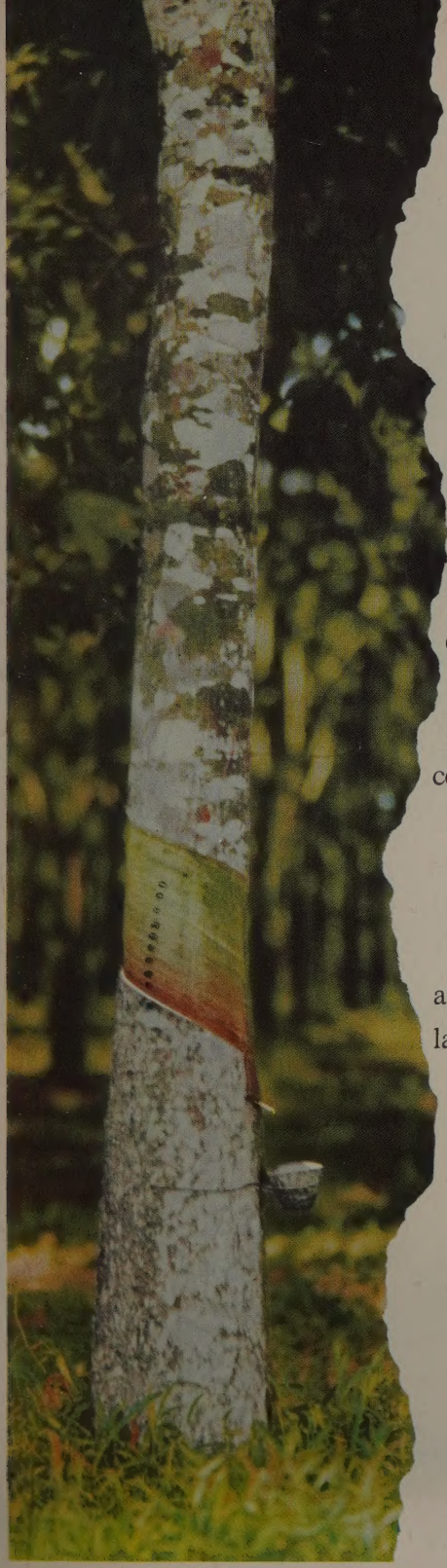

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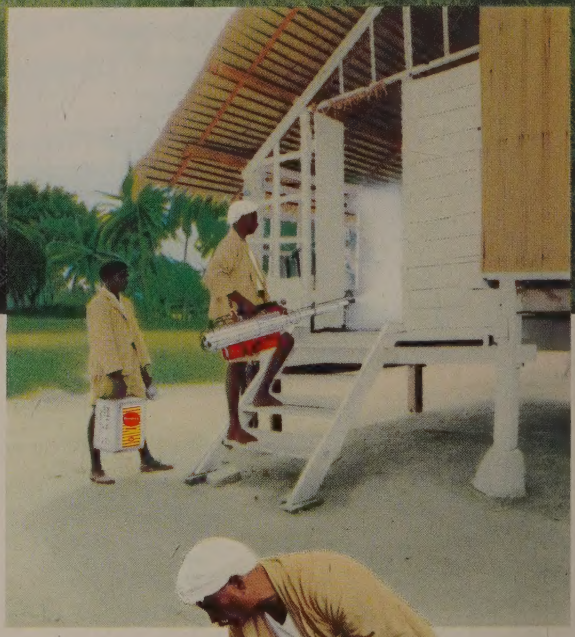

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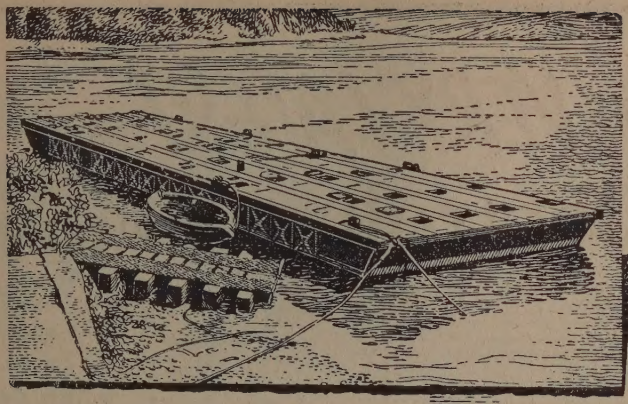

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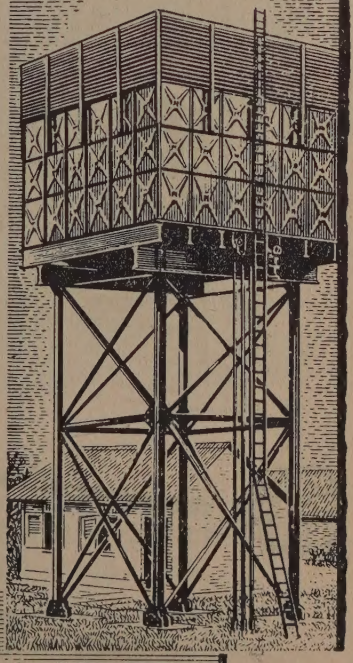

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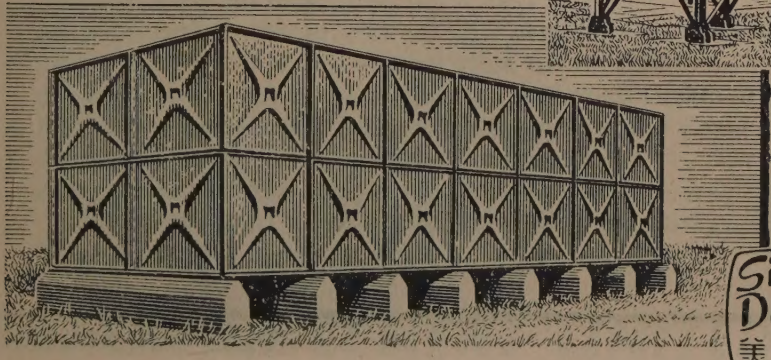

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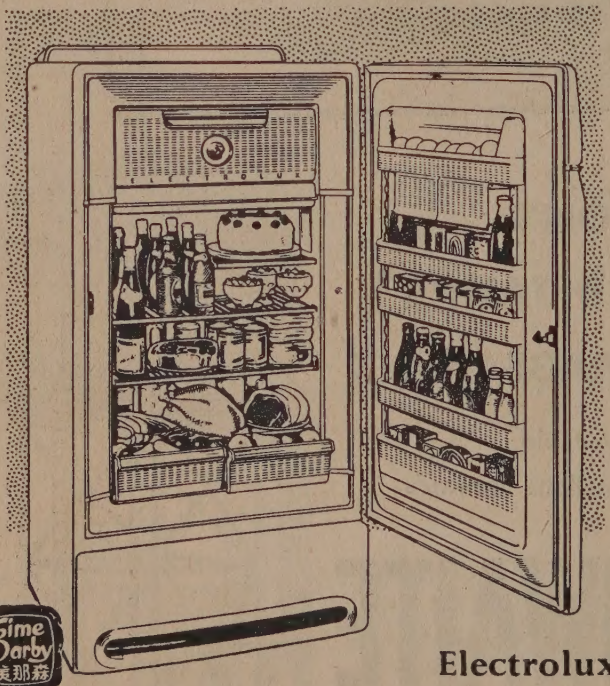

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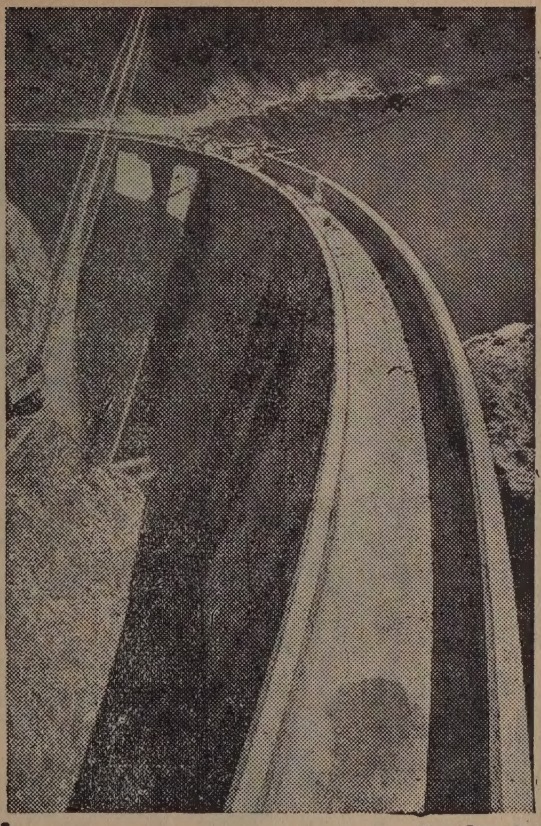

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THE

Malayan Agricultural Journal

Edited by the Publications Officer
with the assistance of the Publications Committee.

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THE MALAYAN AGRICULTURAL JOURNAL

The Journal which is published quarterly, is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extension work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

The price of the Journal is $2/- per copy or $8/- per annum, post free, in Malaya; it is $8.50 or £1 sterling, post free, outside Malaya.

The Journal and other publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the office of the High Commissioner for Malaya in the United Kingdom, Malaya House, London, W.1.

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THE

Malayan Agricultural Journal

Vol. 42, No. 4, 1959

EDITORIAL

One of the major problems in promoting profitable agriculture in Malaya is the inferior quality of the soils in many areas. The coastal districts of the East Coast States are particularly unfortunate in this respect, and the sandy "*bris*" soil, common along many stretches of the coast, is infertile and of very poor texture.

It is therefore of considerable importance to the agricultural economy of this region that a green crop, *Stylosanthes gracilis* (stylo), introduced 12 years ago by the Department of Agriculture, should have proved so successful on even the poorest *bris* soils.

Stylo answers two fundamental needs of the East Coast farmers; it is an excellent cattle fodder, and it helps to enrich the soil both directly and indirectly. As the use of cut stylo fodder increases, the region should be able to support a considerably increased cattle population. Stall feeding of cattle entails the conservation of cattle manure which, in combination with padi straw, provides the cheapest and most efficient form of fertilizer.

Mr. Vivian, State Agricultural Officer, Kelantan, gives in this issue a comprehensive account of the history and uses of stylo to date, and it makes encouraging reading as an example of the practical benefits agricultural research and extension can bring to a depressed area in a comparatively short time.

Padi Stem borers. The problems of resistance to padi stem borer attack are discussed by Mr. Van and Mr. Goh in an article describing recent experiments with Malaya's indigenous wild rice, *Oryza Ridleyi* Hook.

Farm Mechanisation. An important piece of research on padi threshing, carried out by Mr. R. H. Marsden at the request of the Colonial Office and later financed by the Colombo Plan, is reported in this issue. Mr. Marsden came to Malaya to investigate the development of a simple lightweight padi thresher for use by small scale farmers. Malaya was chosen as the centre for this research because of the wide range of conditions under which padi is grown here.

The investigation was successful and the model is now being produced commercially at a price within the means of the average padi farmer.

Development of an Improved Plough. Che Wan Don Mohamad has contributed notes on the development of an 'ideal' animal drawn plough for Malaya. He lists the desirable criteria for such a plough and describes the evolution of the successful prototype.

THE LEGUMINOUS FODDER "STYLO" OR "TROPICAL LUCERNE" IN KELANTAN

(Stylosanthes gracilis)

BY

L. A. VIVIAN,

State Agricultural Officer, Kelantan.

Introduction

Stylosanthes gracilis (stylo) was first introduced to Malaya by the Department of Agriculture in September, 1949, when four ounces of seed were received from the Bureau of Tropical Agriculture, North Queensland, Australia. This seed was planted at three localities in Kelantan; Kota Bharu, Melor and Bachok Agricultural Experiment Stations.

Growth proved very vigorous at all three localities. Once established, stylo smothered all competition from natural weeds and grasses, proved free from pests and diseases and was relished by livestock.

In 1953 the first plot outside Agricultural Experiment Stations was planted on two acres of poor sandy soil at Labok grazing reserve for demonstration to local farmers. In 1956 sufficient experience had been accumulated to warrant encouraging farmers to try stylo on their own land, and nine plots totalling four and a half acres were successfully established. By the end of 1958, 294 plots totalling 115 acres were established, scattered throughout the State on farmers' land. Planting material, barbed wire to enclose the plots, and a little rock phosphate basal fertilizer dressing were supplied free by the Department, and total costs were $8,500. In addition, during 1957, 1958 and 1959, many farmers planted patches of stylo using material obtained from neighbours and as a direct result of observing the crop in the field. Including these spontaneous plantings, total acreage on smallholdings was estimated to be between 500 and 600 acres at the end of September, 1959.

The labour involved in growing and using an area of stylo is frequently much less than that of seeking, cutting and carrying equivalent amounts of natural fodder, particularly during the padi season, The visible bulk of the crop and low cost and labour requirement impressed farmers more than bare figures of yield.

Reports from smallholders have been favourable and the planting of stylo is increasingly steadily. There is every reason to suppose that stylo will become an important permanent fodder crop on smallholdings in the Kelantan Plain, where acute fodder shortage during the padi season is a major problem. The success of this crop demonstrates the rapidity with which well organised extension can effect a fundamental change in farming practice in an area.

The accumulated experience in growing and managing *Stylosanthes gracilis* in Kelantan, during the ten years since its first introduction by the Department of Agriculture, forms the basis for this article.

Description

Stylosanthes is an agriculturally little known genus of the family *Papilionaceae* and is not mentioned in any of the more common books on tropical agriculture. Willis (1) mentions 25 species with a tropical and sub-tropical distribution. From a study of Floras it appears to be distributed in Asia, Africa, North America, and the West Indies, but chiefly in South America. *S. gracilis* H.B.K., the species under discussion, is thought to be native to tropical South America (4). *S. gracilis* has been quoted as a synonym for *S. guianensis* (Brazilian lucerne) (4).

In the field, *S. gracilis* resembles lucerne (*Medicago sativa*) in general appearance and growth habit but is slightly coarser and more vigorous in growth and it is hairy.

S. gracilis has been the subject of trials in numerous tropical countries of recent years and is reported as excellent or very promising by many (6).

In Kelantan, *S. gracilis* will grow on all soils from extremely poor leached sands to poor clays and fertile loams, but will not tolerate swampy conditions. *S. gracilis* is very vigorous; swamps all competition from natural weeds and grasses; is remarkably free from pests and diseases; is drought resistant and persists from three to six years of continuous cropping. Yields of 20 to 30 tons green fodder per acre per annum for the first two cropping years have been obtained on average loams of the Kelantan Plain without manures.

Strains

S. gracilis as grown in Kelantan derives from a single importation of seed. It is very uniform in appearance and extremely pure genetically for a crop on which no formal selection has been practised.

Seven different strains of *S. gracilis*, imported into the State, are now being tested against the Kelantan type. Even at this early stage very wide differences are clearly apparent, from dwarfed, small leaved, low growing woody types to rather large leaved lax growing types.

Clearly, the seed obtained in 1949 was a fortunate importation of an excellent strain. The variable results obtained with *S. gracilis* in some parts of Malaya and in some other countries may be partly due to the use of differing strains.

Planting and Management

Swampy land and dense shade should be avoided, otherwise most sites are suitable, with sunny situation and good drainage giving the best results.

Stylo may be planted direct amongst natural low vegetation with no cultivation other than a blow or two with a *changkol* at each planting point to take the cuttings. Stylo has been successfully established amongst lallang (*Imperata cylindrica*) using this method, planted 4 ft. x 4 ft. with 2 oz. Christmas Island rock phosphate per point at planting and no subsequent maintainance or manuring whatsoever. Such methods give very slow growth and one to two years may be required before a pure, weed free stand of stylo developes sufficiently to harvest the first cut.

For rapid establishment and early fodder production the land should be well cultivated by ploughing and harrowing or changkolling to obtain a deep weed free tilth. Rock phosphate at a rate of 5 cwt. per acre should be applied and worked into the land during cultivation. On poor leached, light, sandy soils, like the coastal sands and the coarse, grey, sandy granite wash soils of the Kelantan Plain, a dressing of cattle dung ploughed in is recommended.

Planting Material

During the first four years' trials in Kelantan, stylo was rarely found to flower and set seed and methods of propagation by cuttings were worked out. Recent evidence shows that well established stylo does flower and set seed annually during March to May, production being most profuse on poor sandy soils following dry weather. Even with profuse flowering, hand seed collection is slow and costly, but the habit of the plant is such that mechanical harvesting of seed could prove practicable, so that commercial seed production cannot be ruled out as a future possibility.

Apart from the original seed introduction, propagation has been done vegetatively. Terminal cuttings about one foot long have proved best for this purpose.

Planting Distance

Planting distance is not critical, but 2 ft. x 2 ft. has been found satisfactory and is most commonly used in practice; 6 ft. x 6 ft. has also proved successful. Planting in continuous rows, cuttings one inch apart in the row with rows 18 inches apart, on small plots gives very rapid cover and early yield.

Planting Method

It is usual to plant three to five cuttings per point with a one inch interval between each cutting. Two thirds of each cutting, including not less than three nodes, should be buried and firmly packed in the soil, leaving one third above ground. Cuttings should be planted fairly erect. This is because sand and soil splashed by rain onto the cutting readily adheres to the hairy stem and leaves, checking and even killing the plants during early establishment. Any excess length above ground is best pinched off.

Best results are obtained by planting in damp soil during showery weather. Extremes of wet and dry should be avoided.

Provided these points are observed the cuttings strike readily and, once growth commences, are extremely tough and resistant to adverse conditions.

Maintenance

Weeding

Stylo will usually dominate and totally smother all natural weeds and grasses unaided by hand weeding, but one weeding round, six to eight weeks after planting, gives more rapid initial estaglishment and earlier yield. A second weeding round may sometimes be advantageous. Once completely established, no further weeding is normally required throughout the useful life of the crop, which may be from three to six years.

Severe cutting for fodder may sometimes allow sporadic lallang and other weeds to gain a foothold among stylo. The cheapest treatment is to rest the stylo and allow it to make sufficient heavy growth to redominate the weeds. Woody growths that make rapid growth in height may need occasional slashing.

Manuring

Only one formal experiment has been done. This was on poor coastal sandy soil at the Agricultural Experiment Station, Bachok. Nitrogen, phosphorus, potasium and calcium were the nutrients tested, singly and in all combinations. The experiment ran for 21 months and was flooded six times during the period. Growth and yields overall were poor in spite of manuring, being only 34,041 lb. fresh green fodder per acre for the eight cuts harvested. The treatment phosphate alone proved highly significant at the one per cent point and the treatment combining phosphate, potassium and calcium proved significant at the five per cent point. The recommendation to apply 5 cwt. rock phosphate per acre at planting is based on this trial and general experience. Fair average crops of stylo remove phosphate from the soil equivalent to 5 cwt. rock phosphate per acre in one crop year so that although no direct experimental evidence exists, it is likely that annual top dressings of this order would be desirable and economic, particularly where fodder is cut, removed, and no dung returned.

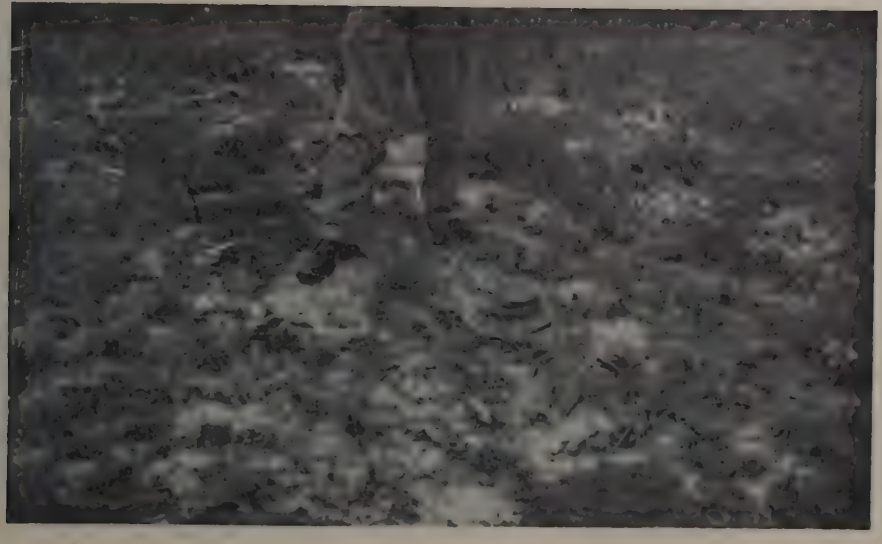
Excellent responses to dung have been observed on poor light soils. Plates I to III show a plot on extremely poor, coarse grey sand at the Veterinary Sheep Breeding Station, Machang, Kelantan. This plot received 2.7 tons sheep dung and 2 cwt. Christmas Island rock phosphate per acre at planting. It yielded 10.6 tons of green fodder per acre from its first single cut seven months after planting. Adjacent plots receiving only rock phosphate at planting yielded only some five tons green fodder per acre per annum over two complete years. This response

PLATE I

PLATE II

Plate I. Stylo, seven years old, left to grow uncut as a monsoon fodder. Plate II, the same, near view. Veterinary Sheep Breeding Station, Machang.

PLATE III



Taken ten yards from Plates I & II, showing extremely sparse grass cover general on this poor grey sandy soil.

PLATE IV

Blanketing mass of tangled stems, many rotting, formed under the stylo cover.

PLATE V

Stylo six months old, planted direct into a thick sward of carpet grass without cultivation. The stylo has established and is beginning to spread.

PLATE VI

Stylo, six months old, on *bris*, i.e., very poor coastal sand.

PLATE VII

Stylo, 18 months old, as a cover crop on a Machang smallholding, cut periodically for fodder.

PLATE VIII

Self-grown stylo, about one year old, dominating dense sheet lallang, Machang.

PLATE IX

Stylo fodder area, two years old, Melor Dry Padi Test Station.

and eye observations elsewhere have led to the present recommendation to apply dung if available when preparing light land for stylo. Periodic top dressings with dung also appear to be markedly beneficial when available.

Some evidence exists that stylo responds to potash and lime on coastal sand soils and it is probably sound practice to include some potash in manuring such soils and also lime where soil acidity is marked. Further experimental work needs to be done before more specific recommendations for manuring stylo can be given.

Harvesting

Very light cuts of erect shoots of stylo may be taken soon after establishment and before the ground is covered. This encourages branching and hastens ground cover. Stylo covers the ground and reaches a height of between two to three feet four to eight months after planting, depending upon soil, weather and treatment. The first full cut may be harvested at this stage.

Height of Cutting

Experiment and experience show that cutting should be done at a height of eight inches to one foot from the ground. Cutting lower than this retards recovery and reduces long term yields. Close cutting during severe drought can kill stylo outright.

Cutting Interval

Recovery sufficient to harvest the next cut usually takes from six to eight weeks. Yields and persistence are reduced if cutting is done more frequently. For a regular daily supply of fodder the stylo area is best divided and pegged out into 40 to 60 equal plots and cut in regular sequence, one plot per day.

These harvesting recommendations have been found to give best overall results on Kelantan Plain loams for yield, persistence, palatability and food value. More severe cutting programmes can give disappointing results. On very poor soils during periods of adverse weather, a more lenient cutting regime may be advisable.

Stylo remains palatable and of good feeding value even if left unharvested for many months, and is very little affected by drought. These characteristics allow great flexibility in utilization to fit stock fodder needs from day to day. Stylo may be left uncut as an accumulating store of fodder against the monsoon, padi season or drought when natural grazing and fodder is short. Lower stems become progressively more woody with age and harvesting cuts must be made above the woody portion on very old stylo, giving some loss of yield where extended cutting intervals of six months or more are used. In practice, this loss may be of less importance than the necessity to have fodder available at specified periods.

Yields

Yields vary greatly with soil, management and to a lesser extent weather. As little as five tons per acre per annum of cut green fodder over two cropping years has been reported on coarse, grey, sandy soils and as much as 60 tons per acre per annum of cut green fodder over two cropping years has been reported from a former cattle paddock on average Kelantan Plain alluvial clay loam.

Table I shows yields of cut green fodder per planted acre per month for 17 cropping months on 0.6 acre plot at Melor Dry Padi Test Station. This was planted October, 1950, manured at planting with 4½ cwt. per acre mixed fertiliser (N 10%.; P_2O_5 11.7%.; K_2O 6.5%) and cut six inches above ground level at a cutting interval of 40 days. The plot was divided into 40 strips and one strip was cut each day. Yields were good during the first seven months, averaging 6,404 lb. per month, but were poor during the following 12 months averaging only 2,217 lb. per month.

Table II gives yields from four trials on Kota Bharu Experiment Station. Technique was similar to that at Melor but no manure was used. Yields were roughly 28 tons fodder per acre per annum in the first full harvesting year on all four trials. The importance of management practice was clearly demonstrated. Close cutting severely checked growth and after October, 1951, the crop was left uncut for three months to recover. Cutting six inches from the ground, as was done in these early trials, is now considered to be too severe for sustained high yields. Eight inches to one foot is the cutting height now recommended.

Table III shows graphically the effect of rainfall distribution on the yield of stylo throughout one year. The yields used are the average for trials (iii) and (iv) at Kota Bharu in 1952 given in Table II. Yield in that year showed a general correlation to rainfall, being highest during and immediately following months of high rainfall, except during December. The reason for the yield drop in December, in spite of increased rain, was almost certainly due to waterlogging acting as a limiting factor. December was the third and wettest month of heavy monsoon rain in 1952.

Left unharvested to grow as a reserve of fodder, stylo can yield ten tons or more per acre of edible fodder at a single cut. Plates I and II show stylo held as monsoon reserve, seven months after planting. Thirteen and a half tons fodder were recorded near the portion shown and the whole plot of half an acre, including patches of poorer growth, yielded 10.6 tons per acre of excellent fodder from one cut.

Two years continuous cropping is the longest period for which records of yield have been kept and no results are available on yield throughout the entire productive life in any one area. Experience shows that during the third and subsequent cropping years yields fall considerably, the crop becoming patchy and of low productivity between three and six years old, depending upon soil and management. The oldest

Table I

Experiment Kn. 54, trial (i). Melor Dry Padi Test Station 1951/52. Planted October 1950.

Yields of stylo in lb. cut green fodder per acre per month.

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total	Average per month
1951	—	—	—	—	—	7,377	11,170	4,712	6,669	6,644	4,525	3,735	44,832	6,404
1952	1,746	1,569	1,976	1,884	2,300	2,969	2,914	2,697	2,284	2,169	2,116	1,980	26,606	2,217

Table II

Experiment Kn. 54, trials (ii), (iii), (iv) and (v). Kota Bharu Experiment Station 1951/52. Planted early 1951

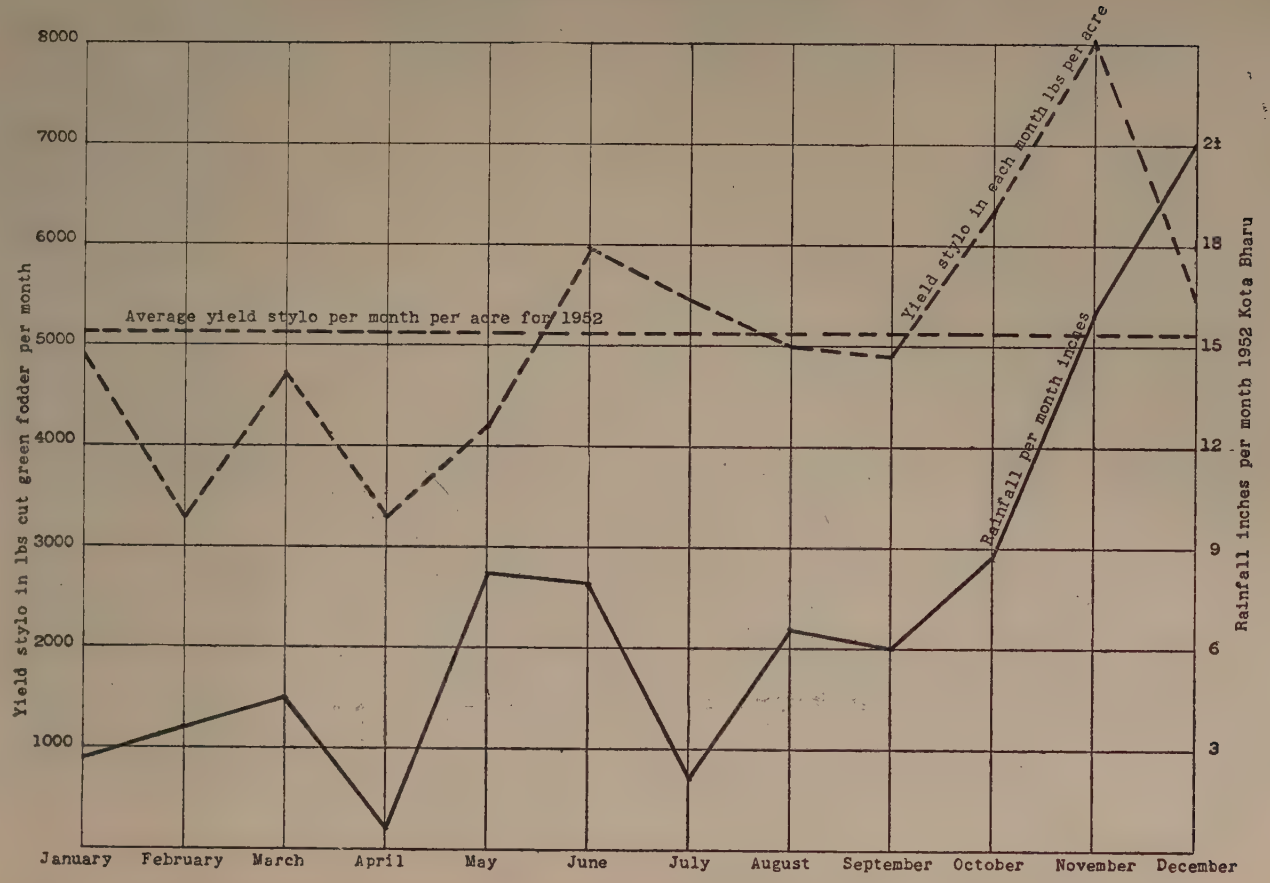
Yields of stylo in lb cut green fodder per acre per month.

Trial and Cutting Interval	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average per month
Trial (ii)	1951	—	—	—	—	—	6,345	10,948	7,115	1,060	8,683	—	—	34,151	4,879
8 weeks	1952	—	4,116	4,816	5,208	5,012	5,922	5,166	6,594	5,334	6,986	7,546	5,572	62,272	5,189
Trial (iii)	1951	—	—	—	—	—	—	—	—	—	—	—	5,808	5,808	5,808
8 weeks	1952	4,812	2,916	6,360	3,324	4,848	5,844	5,052	5,604	5,232	5,916	7,176	6,576	63,660	5,305
Trial (iv)	1951	—	—	—	—	—	—	—	—	—	—	—	8,514	8,514	8,514
6 weeks	1952	4,941	3,717	3,033	3,312	3,609	6,093	5,886	4,392	4,608	6,822	9,162	4,338	59,913	4,993
Trial (v) whole cut every 8 weeks	1952	—	8,974	—	10,822	—	12,208	—	11,368	—	14,518	—	7,266	63,588	5,299

Table III

Experiment Kn. 54, trials (iii) and (iv), Kota Bharu Experiment Station, 1952.

Effect of rainfall distribution on yield of stylo.



plot in the State at present is six years old and is patchy and of low productivity. The soil is very poor and the crop has never been manured, apart from a light dressing of rock phosphate at planting and another similar dressing five years later.

Although limited, the yield data available shows that stylo produces very heavy yields of green fodder, giving 20 to 30 tons per acre per annum for the first two cropping years on average loam soils of the Kelantan Plain with little or no manure. Useful yields may continue from three to six years of age.

Manuring can undoubtedly raise these yields. Future research into manuring and management holds distinct possibilities of increasing the persistance of the crop.

Food Value

Palatability

Stylo is very palatable and is relished by all classes of ruminant stock once they have become accustomed to it. When fed to the total exclusion of all other fodders and grazing at Melor Dry Padi Experiment Station one or two cases of stock temporarily refusing to eat it were noted, but no major stomach upsets occurred. Stylo is almost certainly too rich to be used as sole feed for prolonged periods. In practice farmers feed stylo in conjunction with whatever natural rough grazing is locally available and reports from farmers confirm the high palatability to stylo fed in this way.

Nutrient Content and Digestibility

Stock fed on stylo do extremely well, and this observation has been confirmed by farmers' reports. Table IV shows the chemical composition of green stylo fodder at different ages and compares this with lucerne, cut at early flowering and *Calapogonium mucunoides*, green leaves and stems. The two months old fresh stylo sample from Federal Experiment Station, Serdang, was found to have a moisture content of 76 per cent and all other samples have been corrected to this for case of comparison.

Digestibility coefficients based on formal trials in Malaya are not available. Table V shows the digestible nutrients calculated on data from experimental results on similar crops in other countries (3) with lucerne for comparison. The chemical analysis data show stylo to be substantially similar in this respect to lucerne and confirms the observation that stylo is very nutritions. The analyses show stylo to be high in protein and high in the important minerals phosphorus and calcium. The amounts of phosphorus and calcium are well balanced being within the optimum range 1 : 2 to 2 : 1 in the Kelantan samples and better in this respect than lucerne. In effect, stylo is a bulky concentrate and an excellent supplement to the sparse, low quality natural grazings available. Stylo also has greater nutritive value, weight for weight, than volunteer grasses, etc.

The feeding of bone meal supplements to cattle is a recommended and gradually increasing practice in certain areas of Kelantan, known as deficiency areas, This acts as a preventive for a disease, similar to rickets, common among cows with suckling calves, due to the poverty and low mineral status of the soils and herbage (5). No experimental work has yet been done but it would appear likely that stylo, suitably manured with lime and phosphate, would be an excellent addition to the diet of cattle in such areas, purely on the basis of its high mineral content. Its use would probably prevent the disease without feeding special supplements.

Table IV shows that younger material is slightly richer in food value. This is because when regularly cut for fodder, stylo makes continuous vegetative growth and flowers very sparingly or not at all. Thus the terminal two feet of growth are of similar food value whatever the age of the whole crop and the lower, older, less nutritious portions of the stem affect the overall food value only in proportion to their relative amounts. This useful characteristic of stylo makes yield and the convenience of stock and season the chief factors in determining the cutting age. This is elaborated in the section on harvesting and is in marked contrast to many other common fodder crops, e.g., Guinea grass and Napier grass, which fluctuate greatly and rapidly in yield, food value and palatability with age and season.

Diseases and Pests

To date stylo has proved entirely free from serious diseases or pests in Kelantan. One plot at Jambu Lawar, Ulu Kelantan, was mildly attacked by caterpillars of the moth *Lamprosema diemenalis* Gueen, in 1951. There is a note from Gaja Mati Experiment Station, Kedah, of an attack of *Diplodia* collar rot on a plot there, thought to be due to low starch reserves following close or excess cutting in hot weather. These comprise the only reports to date on pests and diseases and both were unimportant in effect.

Stylo as a Cover Plant

The main interest in stylo has centred on its use as a stock fodder, but its obvious value as a smother plant and possible value as a cover plant deserves mention. Even when regularly cut for fodder, stylo rarely needs any weeding during the first three years. The land remains free from weeds and well protected against erosion. Stylo is being used mainly as a cover plant on a few rubber smallholdings in the Machang district of Kelantan, on very poor drought-prone, grey, sandy soils. In this area the stylo is swamping all low growths, including lallang. In some cases the stylo was planted direct among the weeds and lallang, without manures and without any subsequent maintainance.

In the same Machang area stylo has been a very useful boundary plant to keep sheet lallang from encroaching onto cultivated land. Once established, the stylo "hedge" gains from three to ten yards into the

Table IV

Comparison of chemical composition of *S. gracilis* at different ages (i.e. since previous cutting) with that of lucerne (*Medicago sativa*) and *Calopogonium mucunoides*. Moisture corrected to 76%.

	S. gracilis from F.E.S.S. 2 months old.	*S. gracilis* from Kelantan 2 months old.	*S. gracilis* from Kelantan 4 months old.	*S. gracilis* from Kelantan 6½ months old (i.e. from time of sowing	*M. sativa* in early flower (2)	*C. mucunoides* Green leaves and stems
Water	76	76	76	76	76	76
Protein	3.9	4	2.9	3.1	4.1	3.7
Fat	0.6	0.4	0.5	0.4	0.4	0.6
Soluble CHO	10	9.6	9.9	9.1	9.9	10.6
Fibre	7.2	7.6	9	9.5	7.2	7.6
Ash	2.3	2.4	1.7	1.9	2.4	1.5
	100	100	100	100	100	100
Lime as CaO	0.54	0.52	0.41	0.51	0.96	0.48
Phosphorus as P_2O_5	0.13	0.31	0.21	0.31	0.12	0.1

Table V

Calculated digestible nutrients in *S. gracilis* green fodder with those of lucerne (*M. sativa*) for comparison.

Feeding Stuff	Calculated Digestible Nutrients				Dry Matter %	Calculated from Digestible Nutrients		Lime as CaO %	Phosphorus as P_2O_5 %
	Protein %	Fat %	Carbohydrates			Nutritive Ratio 1 :	Starch equivalent lb.		
			Soluble %	Fibre %					
S. gracilis 2 months old from Kelantan	2.3	0.1	4.5	1.6	24	2.8	8.4	0.52	0.31
M. Sativa at early flowering	3.1	0.1	6.6	3.2	24	3.2	10.0	0.96	0.12

lallang per annum. In two or three cases stylo seed has blown several yards into thick sheet lallang and established vigorously, gradually swamping the lallang. Plate VIII shows an example photographed in the Machang area.

The growth habit of stylo is worth noting in connection with its smothering abilities. After covering bare ground stylo grows and supports itself more or less erect three to five feet high or more unaided. Eventually it collapses back upon itself under the influence of rain, wind or its own weight, forming a tangle of stems one to three feet thick from which height a new "storey" of growth continues from the tips of the collapsed branching stems. Grasses and similar low growths that make new growth from ground level are at a marked disadvantage and eventually are overtopped and completely die out under the weight and shade of the stylo.

Stylo is a leaning plant and does not climb shrubs or saplings, as is the case with creeping covers, and it is very easily rolled back from planting rows, as it tangles into a continuous thick carpet.

Soil Improvement and Erosion Control

A tremendous bulk of blanketing vegetation is formed by stylo, giving excellent protection from sun, rain and surface wash.

Roots

Only a few observations on rooting habit have been made, but these show it to root vigourously and, on dry soils, to a considerable depth. On one sandy site roots five and a half feet deep were found reaching the level of the permanent water table. The greatest mass of roots is in the top nine inches of soil, but they are commonly found to depths of two and a half feet on most sites examined. These sites were almost all regularly cut for fodder, and for part of the year high water tables were frequently limiting.

Nodulation

Root nodules are small but numerous on the fine rootlets and the plant is an efficient nitrogen fixer, judging by bulk and chemical analysis of the foliage. The nitrogent in a fair crop of 30 tons per acre is equivalent in amount to the nitrogen in about 18 cwt. sulphate of ammonia per acre per year.

Mobilization of Nutrients

In spite of the apparent paucity of Kelantan soils in lime and phosphorus, stylo roots appear able to mobilize and extract these in large quantity, the foliage being very rich in both. A 30 ton per acre per annum crop contains about 350 lb. CaO and 208 lb. P_2O_5.

Competition with Tree Crops

In Ceylon, the use of *S. gracilis* as a ground cover in young rubber is at present discouraged on the grounds that with its strong root system it competes with young rubber, particularly for water (7). In Kedah a

S. gracilis cover in a rambutan orchard on Gajah Mati Agricultural Experiment Station is thought to be competing with the tree crop on a poor lateritic piece of rising ground. In Kelantan, however, no obvious cases of competion with tree crops have been reported. On the contrary, several cases of tree crops becoming greener and more healthy with *S. gracilis* as a ground cover have been noted. A possible explanation is that many sites on the Kelantan plain suffer more from periodic high water tables than the reverse. In Kelantan, too, most stylo areas are regularly cut for fodder, which reduces transpiration and perhaps also competition for water, as against when the crop is used purely for cover.

Experimental work on *S. gracilis* as a cover under Malayan conditions is necessary, and is at present being done for rubber by the Rubber Research Institute of Malaya. Until further accurate data becomes available, conflicting reports indicate that the use of *S. gracilis* purely as a cover among tree crops should be limited to small trials and observations.

Summary

Seed of *S. gracilis* was imported from Queensland, Australia in 1949. It is a little known genus of the family *Papilionaceae,* thought to be native to tropical South America. The crop proved adaptable to all soils in Kelantan except in swampy situations. The imported strains proved very vigorous and drought resistant, smothering all weed competition. Seed production was sparse at first but vegetative propagation, using terminal cuttings one foot long, proved easy. Yields were 20 to 30 tons green matter per acre per annum for the first two cropping years without fertilizers, falling thereafter. The crop persists from three to six years. Harvest cuts should be not more frequent than once in 40 days; height of cut eight inches to one foot above ground level giving the best long term yields Close cutting or heavy grazing can kill the crop. The fodder is palatable and highly nutritious, being very rich in protein, calcium and phosphorus. Some 600 acres were estimated to be grown by Kelantan farmers on numerous small plots by September, 1959, and the area was rapidly increasing.

S. gracilis is of obvious value as a soil cleaning, improving and protecting crop. Observations on the possible value of stylo as a ground cover among tree crops are the subject of present experiment.

Acknowledgements

The material for this article comes mainly from the files of the Department of Agriculture, Kelantan, the results of ten years work by field staff too numerous to mention by name, but whose invaluable work is acknowledged with thanks. I acknowledge in particular the work of Mr. H. K. Ashby, formerly State Agricultural Officer, Kelantan, whose unpublished reports on early experiments provided much basic data; and thank Mr. P. R. Wycherley, Botanical Division, Rubber Research Institute, Malaya, for data on preliminary trials with *S. gracilis* as a cover plant.

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A SMALL RICE THRESHER FOR PEASANT GROWERS

BY

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(Reprinted from the "Journal of Agricultural Engineering Research.")

Introduction

In 1956 a request was received to investigate the development of a simple lightweight thresher capable of increasing the output per man hour without damaging the grain. At that time much scepticism had arisen about the use of mechanical threshers because experience with available machines, usually heavy peg drum types, had shown a very high degree of damage. Such experience had given rise to the idea that rice was very susceptible to damage when threshed mechanically and smallholders were consequently averse to changing from their traditional methods.

These harvesting and threshing methods are primitive and have remained unchanged for generations. They have been evolved in accordance with climatic conditions, local customs and trades such as rope and mat making. There are many variations of two basic techniques, which can be directly related to areas of high and low humidity. Where the humidity is high the grain must be threshed immediately after reaping, which is carried out by women using a small knife and leaving small bundles or sheaves with the heads all together. The men follow the reapers around the field threshing out the sheaves by swinging them over their shoulder and beating them down into a wooden tub or *tong*. With this method grain losses are high because of shedding and incomplete threshing. Where the humidity is low, the paddy is carried to a central site, where it is placed in a heap and threshed out by treading, usually by buffaloes or oxen. With this method the incidence of damage can be high and there are also shedding losses arising from the amount of handling involved.

The broad specification drawn up for a thresher suitable for the peasant paddy grower was along the following lines:

(a) The throughput should not be less than 200-250 lb/hr: it was estimated that one man, under favourable conditions, could thresh out between 90 and 100 lb/hr.

(b) Threshing should be complete and the sample contain not more than 1% broken grains.

(c) The weight, excluding the engine, should not exceed 200 lb. so that the thresher could be man-handled around the field or carried to fields not accessible to heavy equipment or transport.

(d) The design should be kept as simple as possible because the labour likely to be operating it would not be used to machinery, and in order to keep the price low.

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(e) If possible the machine should blend into existing traditional harvesting methods in order to encourage growers to accept mechanical threshing.

Work on the project was carried out in two phases. Firstly, a general investigation into mechanical threshing of paddy on peasant holdings with particular reference to damage and throughput and secondly, the development of a small thresher based on its findings.

The field trials were carried out in the Federation of Malaya. About 2,000 varieties of paddy are reputed to be grown in different parts of the world under widely varying conditions and, although Malaya by no means offered such a wide scope, the range of varieties and conditions was considered to be perhaps more diverse than in any other country.

Preliminary investigations into the mechanical threshing of paddy.

The object of these investigations was to find the causes of damage to the grain, reported in earlier work (1), and means of preventing it; to determine the rate of throughput in relation to dimensions, drum speed and concave setting, as well as the effect of grain moisture content upon throughput and damage; and to evolve the most suitable type of mechanism to be incorporated into a thresher designed for the smallholder.

Test rigs (Plates 1 and 2) were constructed for investigations on:

(i) a steel rasp bar drum;
(ii) a rubber rasp bar drum;
(iii) a peg drum;
(iv) an endless belt fitted with rubber rasp bars;
(v) an endless belt fitted with steel pegs.

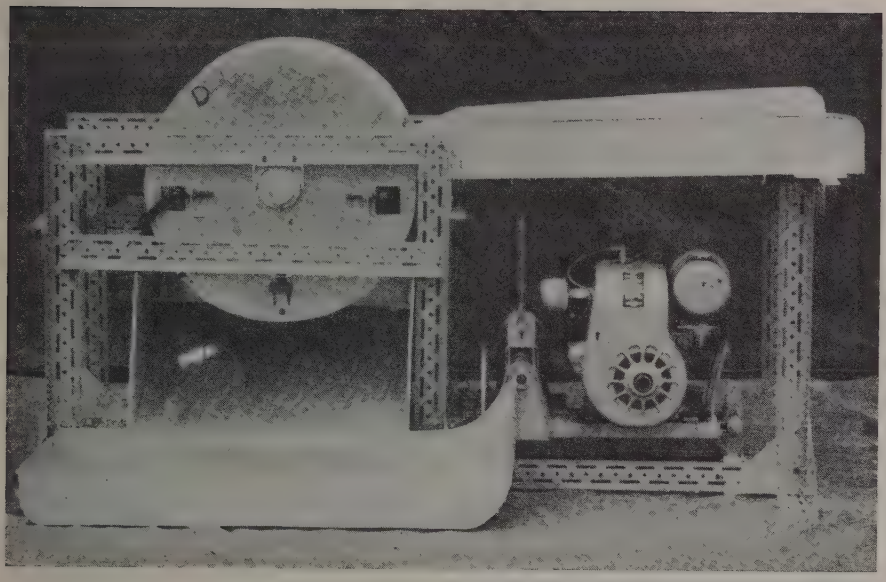
All the units were 12 in. wide internally and the drums had tip circle diameters of 18 in. (Table I). The endless belts were carried by pulleys arranged to give the rasp bars and pegs an effective tip circle diameter of 18 in. as they passed the concave. The concaves were of an open wire type; teeth were fitted to those used with the peg units. Thus the principal dimensions of all the units were similar. Power was provided by a 4-stroke, air cooled petrol engine of 288 cu. cm.

The reason for including the rubber rasp bar drum, and endless belt threshing mechanism (2) was the high incidence of grain damage reporter in earlier work (1). The principle of endless belt threshing offers the advantage that the grain is threshed out at relatively low speeds, thus minimizing the damage. In the test rigs, the belt was supported by two pulleys and the rubber rasp bars or pegs were secured to the outside face of the belt. The concave extended 180° around the larger pulley leading on to the stationary separating screens situated beneath the lower run of the belt (Plate 3).

The trials showed that there were three main defects with both belt units:

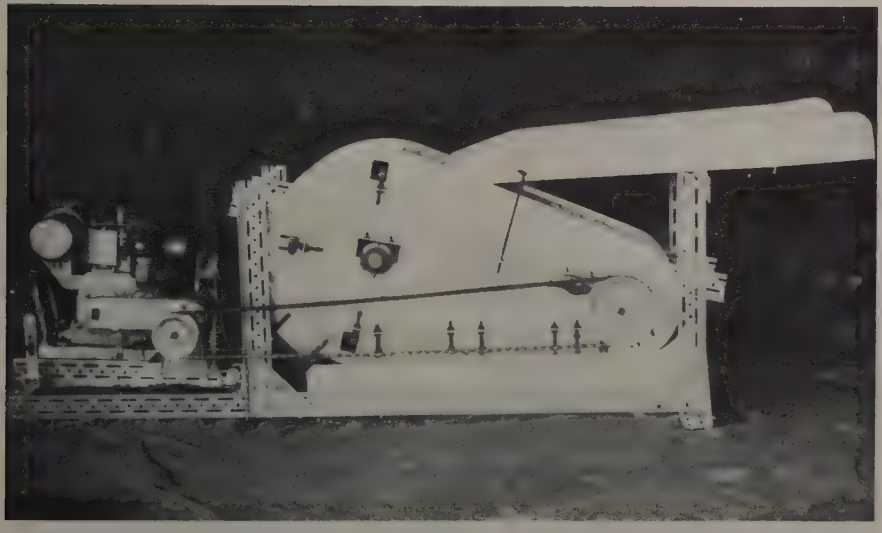
(a) The screens were not effective in separating the loose grain from the straw; this may be attributed to the lack of a third

PLATE 1



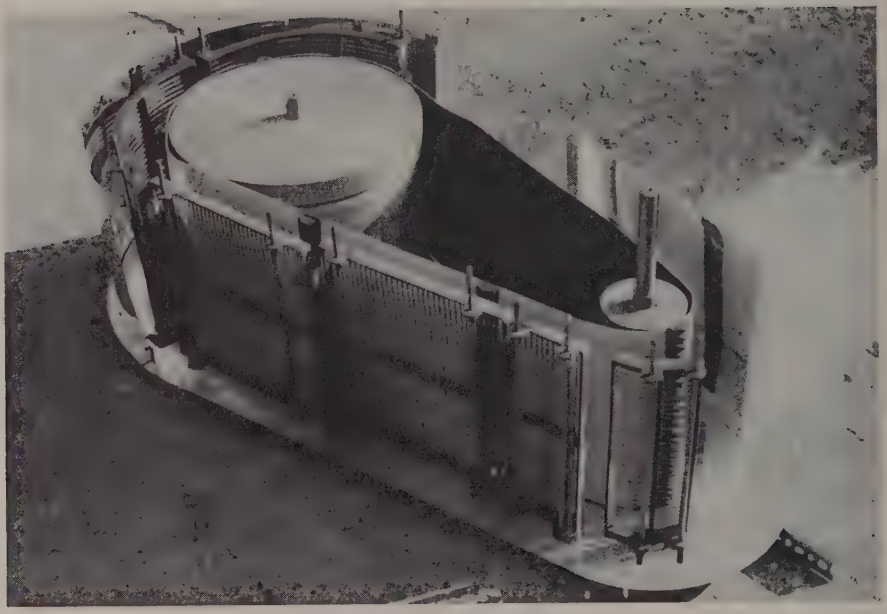
Test rig with 18 in. drum.

PLATE 2



Test rig with endless belt mechanism.

PLATE 3



Endless belt mechanism.

PLATE 4

Prototype thresher with 12 in. dia. steel rasp bar drum.

idler roller mounted so as to curve the run of the belt as it passes over the separating screens.

(b) The edge effect noted previously (2) was serious on account of the narrow width of the belt.

(c) Both the rasp bars and pegs, especially the latter, were very difficult to secure to the belt, in this case chrome tanned leather backed with nylon.

With the rubber rasp bar belt rig, the wear on the bars was excessive and either complete bars or parts of them were frequently shed. In the peg belt unit the loss of pegs was so great that the runs were stopped after a time. The endless belt mechanisms were clearly unsuitable.

Table I

18 in. Test Rigs.

Mechanism	Drum/belt speed, ft/min.		Grain moisture content, %		Output of threshed grain, lb/hr.		Total threshing time, min.	Total weight of threshed grain, lb.	Average throughput, lb/hr.
	Max.	Min.	Max.	Min.	Max.	Min.			
Endless belt, rubber rasp bars	4000	2400	>24	13	800	300	364	3033	497
Endless belt, steel pegs	4000	2000	>24	11	980	380	271	2851	633
Rubber rasp bar drum	5600	3000	17	12	1210	460	324	5664	785
Steel rasp bar drum	5600	3600	>24	12	1450	380	602	6936	692
	5900	4080	—	—	—	—	465	9633	1234
Peg drum	5400	2800	>24	12	1100	220	440	4877	665
Peg drum modified	6350	3300	>24	12.5	1650	355	1875	25385	849

Similar difficulties were encountered with the rubber rasp bar drum. The heads of grain were completely threshed out without damage, but the rubber rasp bars were rapidly worn smooth. It must be borne in mind that there were only four 1 ft. bars to do all the work and each was therefore subjected to a higher rate of work than would be encountered by a conventional drum. Moreover, paddy husks are exceptionally abrasive due to their high silica content. However, this rapid wear led to the discarding of the unit at the end of the season, particularly in view of the negligible damage associated with the steel rasp bar version.

The steel rasp bar drum proved to be an effective mechanism for threshing paddy. At speeds below 3,600 ft/min, the threshing became

incomplete whereas running at speeds of up to 5,000 ft/min. did not appear to increase the amount of damaged grains in the sample or the rate of throughput. The rate of output was much higher than had been anticipated and it was considered that a 12 in. drum would be adequate for a peasant paddy grower.

This drum was able to thresh out the heads of grain completely and without causing a high proportion of damage in the sample under a wide range of crop varieties and grain moisture contents. In view of the satisfactory performance of this unit it was decided to retain it as a standard of comparison in future trials. This seemed to disprove the widely held belief that a peg drum is essential to thresh paddy. With the unit used initially the pegs on the drum and the concave teeth were considerably smaller and more numerous than is conventional; consequently, the unit was modified so as to be more in line with general practice.

Although the peg drum gave very much higher rates of throughput than had been requested in the original specification and the quality of the threshing, both in terms of completeness and lack of damage, was excellent, the overall throughput was lower than that of the equivalent rasp bar type. Moreover, the construction had to be stiffer in order to ensure that the lateral clearance between the pegs and the teeth remained constant.

The assessment of damage was simple and consisted of expressing the percentage, by weight, of the broken grains in a representative sample obtained during the course of the trial run. The broken grains were selected by naked eye and no attempt was made to evaluate the significance of microscopic hair cracks in the husks of the grain.

Although not providing any evidence to show the causes of grain damage encountered with commercial drums, the result showed that the arrangement of the test rig open wire concave and drums having only four widely spaced rasp bars or pegs would produce a damage-free sample. With a minimum concave clearance of 3/16 in. and peripheral speeds of the drum within the range 3,000-5,000 ft/min. (2,000-4,000 ft/min. in the case of the endless belts), no grain damage occurred; however, no clear-cut relationship was established between grain moisture content and rate of throughput. The threshed samples contained varying amounts of contamination consisting of pieces of broken straw, but presented no difficulties with existing hand methods of cleaning.

During the earlier stages of the field trials the test runs were all of short duration (about 10-15 min); this procedure was adopted to ensure that the grain moisture content remained constant during the course of the run.

Although no precise measurements of the power consumption were made, the engine used appeared to have an adequate reserve of power.

Field trials with the prototype thresher.

The results obtained during the preliminary trials provided valuable data for the design of the prototype thresher for the paddy grower.

It was decided to use a 12 in. dia. steel rasp bar drum fitted with three bars equidistantly-spaced around the circumference. The concave was of the open wire type and the other components, such as feed tray, drum casing and main frame were as simple as possible (Plate 4). The engine selected was a 150 cu. cm 4-stroke air-cooled petrol model developing a maximum sustained output of 2½ h.p. In other respects the machine conformed to the specification given above, except that the total weight including the engine was 210 lb.

Field work with the thresher commenced in December, 1958, in Kedah and was completed in Malacca early in March, 1959. Initially the thresher was used in the field in conjunction with large prepared heaps of paddy. The loose grain and straw on being ejected from the machine were prevented from scattering over a wide area by a tarpaulin screen held on poles driven into the ground. The machine stood on a second sheet of tarpaulin spread out to catch the threshed material, which was then bagged off by hand.

By this method it was possible to obtain very high net rates of output, the maximum recorded being 2,150 lb/hr. However, the overall amount of time consumed was fairly high. Dismantling, moving and re-erection of the thresher and screens took about ½ hr. in the threshing; consequently there was a tendency to bring the crop to the machine. The women who had done the reaping carried the paddy in armfuls at a time and the total working hours consumed in building the heaps and moving the machine was approximately equal to the time taken to thresh the crop by the traditional hand method. In a square, 1 acre field, it was found that moving the machine three times presented the optimum working arrangement.

In countries where it is customary to thresh at a central site, e.g. by the treading action of animals' feet, the heaps are prepared for threshing in any case, but where the threshing follows the reapers around the field, the transporting of the paddy to the threshing site must be considered as additional work.

Local farmers were generally agreed that about 5-10 per cent more grain was being obtained as compared with hand-threshing, which is seldom complete and involves some losses of loose grains.

Five men were required to operate the thresher; to hand the paddy to the feeder, to feed it into the machine, to rake away the straw, and to bag off the grain, with one operator assisting where required. The average rate of throughput by this method in heavy yielding crops was 1,125 lb/hr.

It was clear that economies in labour costs would be achieved if the machine were modified so that it could be moved around the field in the same manner as the *tongs*. The basic problem was to provide an alternative to the tarpaulin screens for catching the loose grains carried over with the straw.

The grain only could have been collected by means of a simple cowling, but it was considered that the volume of straw being ejected

would have caused blockages in such a cowling. It was therefore decided to investigate the principle of head stripping where the heads only are allowed to come into contact with the threshing drum and the straw does not pass through the machine.

A simple head stripper was built locally and consisted of a spiked drum of 12 in. tip circle diameter driven by a 120 cu. cm 4-stroke air-cooled petrol engine and supported on a wooden frame (Plate 5). A canvas shroud directed the grain into a collecting box situated beneath the drum. It was envisaged that the machine would directly take the place of the *tong* in the field as it was sufficiently light and portable to be pulled around on its skids following the reapers, thus fitting in with traditional methods. The straw remained suitable for making up into mats etc. and it was not necessary to have a man raking the straw at the outlet of the machine. Thus, although the output from the machine was not expected to be high, it was thought that the output per man-hour would be substantially increased.

However, the threshing performance proved to be very poor. The bundles of paddy offered to the drum had to be small to ensure that the grains in the middle were all threshed; complete, but unthreshed, ears were passed into the collecting box and there seemed to be no method of preventing an undesirable amount of straw passing over into the sample.

Consideration was then given to fitting a concave, but it was decided that for experimental purposes it would be simpler to fit an end cowl and curtain to the prototype thresher and use it as a head stripper. This was done and crude wooden skids were fitted to enable it to be dragged around the field after the reapers. The grain was collected in a large wooden box.

The results showed an improvement over the head stripper, but the size of the bundles which could be used was still very limited and therefore the output was low compared with that obtained when the straw was allowed to pass through the machine. Runs were made with this model at various drum speeds and concave settings, but these adjustments had little effect on the amount of straw passing through into the sample which, however, did not contain any complete unthreshed heads.

All the work on head stripping had to be carried out in crops having a poor yield, but the other thresher was also used under the same conditions and therefore a direct comparison was available. Table II shows the differences in maximum and average throughputs between these two machines. In order to allow the straw to pass through the machine without the use of the large tarpaulin screens, thereby offering the mobility necessary to follow the reapers around the field, the canvas curtain at the rear of the prototype thresher was shortened and the collecting box surrounded on two sides with a small canvas screen (Plate 6).

In practice, no difficulty was presented by the need to rake the straw away quickly. As with the original model, five men were required

PLATE 5

Head stripper test rig.

PLATE 6

Prototype thresher in work.

to operate the machine to full capacity; but in this case two men were required to gather up the paddy. As the reapers were followed around the field, there was no time lost in preparing heaps. Operated in this manner, the machine was able to keep pace with fifteen women reaping, whereas when threshing by hand, four men were able to follow only six reapers. The crops available for these trials were poor in yield and the average rate of throughput was only 389 lb/hr. with a maximum of 587 lb/hr.

Discussion of results.

The maximum amount of broken grains recorded during the runs with the test rigs was 0.4 per cent and may be considered negligible. During the initial run with the prototype thresher using a minimum concave clearance of only ⅛ in. and a drum speed of 4,720 ft/min. the amount of broken grains was 1½ per cent. Subsequently it was found that complete threshing with negligible broken grains could be obtained with a minimum concave clearance of 3/16 in. and a drum speed of 4,720 ft/min. These settings gave satisfactory threshing at all grain moisture contents and rates of throughput.

The considerable scatter of results for the rates of throughput for all the machines shown in Table II cannot be explained by any one simple factor. Since the output of the thresher is necessarily tied to the weight of grain on the crop which is being fed into it, the yield of the crop has an important influence; it may vary from almost crop failure to 3½ t/acre, or even more.

The rate at which the crop was fed into the machine was also a very important factor. It was observed that the men were able to thresh by hand for only about half a day, whereas using the machine, a full day's work was possible, although the fatigue induced had a slackening effect towards the end of the day.

Table II

12 in. Prototype Thresher and Head Stripper.

Method of use	Drum speed, ft/min.		Grain moisture content, %		Output of threshed grain, lb/hr.		Total threshing time, min.	Total weight of threshed grain, lb.	Average throughput lb/hr.
	Max.	Min.	Max.	Min.	Max.	Min.			
Threshing from large prepared heaps	5650 4720	4400 4100	21 19	13 —	1688 2150	568 714	3179 997	59745 23857	1125 1385
Following the reapers around the field	4720	4560	>24	13	576	179	1893	12072	389
Following the reapers around the field. Head stripping	4720	2640	18	13	526	132	806	2861	257
Head stripper	1885	—	17	12	173.5	41	114.4	1419	85.6

The prototype thresher gave a higher rate of output than the test rigs since it was easier to use, although the latter had larger drums.

Conclusions

The results and experience gained during the course of the field trials have shown that it is feasible to produce a small mechanical thresher for the peasant paddy grower. Such a machine, although only in prototype form, was readily accepted by the growers; the 12 in. dia. steel rasp bar thresher adequately fulfilled their requirements. A particular advantage of the machine lay in the flexibility of its application, enabling it to be used in any of the following ways:

(a) Threshing from large prepared heaps. With this method, the rate of output and labour requirement, particularly that for preparing the heaps, are high, but the method is acceptable in countries where it is customary to thresh at central sites.

(b) Following the reapers around the field. This eliminates the use of labour for heaping, but the overall throughput is not as high as with (a).

(c) Head stripping. This method has the lowest labour requirements; the bulk of the straw is left in an undamaged condition, but the throughput is lower than with the other methods.

Acknowledgements

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THE RESISTANCE OF *ORYZA RIDLEYI*, HOOK., TO PADI STEM BORER ATTACK

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Introduction

It has long been recognised that the most serious pest of padi in Malaya is the stem borer. Wyatt (1) in field investigations of stem borers on farmers' fields in North Krian District, reported economic losses of as high as 26.5 per cent of the total crop, even after factors compensating for loss of yield had been taken into account.

Chemotherapeutic treatment is one of the ways of reducing losses due to stem borers in padi. For such treatment to be economical, it should be done at the right time, and the benefits derived equated in terms of cash should outweigh the cost of such application. Furthermore, the question of toxicity to fish, which form an appreciable part of the income of the padi cultivator, has also to be considered when chemotherapeutic treatment is used. If, therefore, stem borer resistant varieties could be bred, their use by the farmers would save them losses due to stem borers without extra effort and money.

Oryza ridleyi, Hook., has been observed as early as 1955 to be relatively free from stem borer attack when grown amongst *Oryza sativa* L.

Oryza ridleyi was first reported by Ridley (2) and published by Hooker as growing wild in the swamps and river banks in Malaya. It is probably indigenous to the country and the surrounding regions (Laos, Borneo, Sumatra, Thailand and New Gunea) (3, 4).

Although *O. ridleyi* has been reported to be growing wild in various parts of the Malay Peninsula it is by no means common and there has always been difficulty in finding it. Material for study was only obtainable after E. F. Allen, former Senior Agronomist of the Department of Agriculture, Federation of Malaya, "rediscovered" it growing on the river banks of the Perak River at Layang Layang Kiri, Perak, in 1954. Seeds were eventually collected, germinated and grown in a protective cage at Kuala Lumpur, and all subsequent studies and observations on this species were carried out on the material grown at Kuala Lumpur.

As a result of observations by the senior author that *O. ridleyi* has been relatively free from stem borer attack when grown amongst *O. sativa,* investigations were initiated to test the resistance of this species to padi stem borer.

Material and Methods

O. ridleyi and *O. sativa* (variety Pebifun) were planted in pots and at maximum tillering stage they were subjected to the following tests. These tests were carried out for two seasons.

(a) *Inoculating young borer larvae on to plants*

Newly hatched *Chilo suppressalis* larvae were transferred on to the stems of *O. ridleyi* and *O. sativa* by means of a fine camel hair brush. Each pot received the same number of larvae. The plants were examined for borer damage after four weeks.

(b) *Exposing plants to padi stem borer attack*

In this test the plants were placed in pairs (one *O. sativa* and one *O. ridleyi*) in a bird proof cage. Padi growing in this cage has always suffered from stem borer attack and for this test therefore ample opportunity for attack was afforded the test plants if they were susceptible. The plants were examined at the end of two months.

Results

(a) *Inoculating young borer larvae on to the plant*

The results of the first season may be regarded as exploratory since complete data was not available. Both *O. ridleyi* and *O. sativa* exhibited signs of borer attack. Tillers which showed signs of borer feeding marks were cut open and examined. The results were as follows:-

Varieties	No. of Tillers Bored	No. of Tillers with Larvae Present
O. ridleyi	2	0
O. sativa	3	1

Results for the second season were more interesting which are as follows:—

Pot No.	Padi Variety	Total Tillers	No. of Bored Tillers	% Bored	No. of Borers Recovered from Bored Tillers
1	*O. ridleyi*	38	6	15.6	2
2	„	23	7	30.4	1
3	*O. sativa*	20	11	55.0	10

(b) *Exposing plants to padi stem borer attack*

The exposing of plants to natural attacks of stem borers was probably comparable to conditions existing in farmers' fields. Therefore, results obtained from this experiment would bear a closer relationship to those obtainable on cultivators' fields, rather than in test (a) above, in which stem borers were artificially introduced to the plants.

In the first season test, the number of bored tillers were much higher in *O. sativa* than *O. ridleyi* in every case examined. In two cases no tillers of *O. ridleyi* were bored. The results of the test were as follows:—

Pot. No.		Variety	Total Tillers	No. of Bored Tillers	% Bored
A.	1	*O. sativa*	14	12	85.71
	3	*O. ridleyi*	73	0	0
B.	2	*O. sativa*	12	11	91.67
	4	*O. ridleyi*	30	0	0
C.	3	*O. sativa*	10	8	80
	5	*O. ridleyi*	55	3	5.45

In the test carried out for the second season, the plants grew very poorly and detailed records were not taken. However, in general observations, all tillers of *O. ridleyi* were free from attacks of stem borers while signs of attack on *O. sativa* were noticeable, but were much less than that of the first test.

Discussion

The investigations were not of formal design but the results obtained can be used as a basis for certain broad conclusions. In the tests carried out with artificial inoculation, the stem borer larvae had no natural choice as obtained in the field. In the circumstances it can reasonably be assumed that the first reaction would be for the larvae to bore into the stem but that after gaining entry, conditions in the stem were found to be unfavourable for its continued existence (see below). This would probably account for the low recovery of borers in bored stems of *O. ridleyi* in the second season's experiment. The fact that six and seven tillers in *O. ridleyi* were bored in comparison to eleven in *O. sativa* could also be explained by the Hobson's choice offered to the borers. On the other hand, more favourable conditions existed in the softer stems of *O. sativa* and the larvae were able to feed and continue living. Of the ten borers recovered from *O. sativa* it is interesting to note that nine have pupated.

The tests carried out by exposing plants to the natural attack of stem borers strengthens the arguments in the test discussed above. This observation clearly indicates that there is a decided preference by stem borers for *O. sativa* to *O. ridleyi*. Whether this preference for *O. sativa* or avoidance of *O. ridleyi* is due to chemical or mechanical

properties or both in *O. ridleyi* is not known. But it is a fact that *O. ridleyi* has a much harder stem than *O. sativa.* In *O. ridleyi* the layer of cells in the stem from the epidermis to the hollow pith is thicker than in *O. sativa* and is mainly sclerenchymatous. In *O. sativa* this layer is mainly parenchymatous. Because of this, it is most probable that this thick sclerenchymatous layer of the stem acts as a barrier to attacks of the borers. *O. ridleyi* has a very small pith and it is also likely that this offers very little free movement to the larva even if it succeeds in getting through the thick sclerenchymatous layer.

If resistance to stem-borer attack in *O. ridleyi* is due to its thicker sclerenchymatous layer and small pith then synthesis of varieties, having these properties, by hybridization should be explored. Admittedly in the inoculation test, *O. ridleyi* was attacked by stem borers, and if varieties with the properties were developed and planted as a monoculture attacks by stem borers are still possible in the absence of ordinary *O. sativa.* Attack is however unlikely because in another test (unpublished) in which *Chilo suppressalis* pupae were enclosed with *O. ridleyi* plants, by means of a wire gauge cage, no stems were bored although 57 per cent of the pupae were recovered as adults, but no eggs were laid. Therefore, even if attacked, the damage should be negligible.

On the results of the tests carried out so far, it is the opinion of the authors that *O. ridleyi* shows a high degree of resistance to attacks by stem borers. Further work, however, is needed to elucidate any other factors, apart from physical characteristics, that may play a part in the resistance of *O. ridleyi* to stem borers.

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SOME NOTES ON THE DEVELOPMENT OF AN IMPROVED ANIMAL DRAWN PLOUGH

BY

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Introduction

The animal drawn ploughs most widely used in Malaya may be divided into three categories, the Kedah, Malacca and Japanese type ploughs. Recently, investigations into modifications of existing designs have been made by officers of the Department with a view to incorporating the following desirable characteristics, and thus evolving an 'ideal' plough for Malayan conditions:

Lightness and a suitable shape so that it can be conveniently carried over the shoulder.

Frame made of straight pieces of wood requiring the minimum of preparation. Particular attention to be paid to the type of wood used, for its durability and strength, as well as lightness.

Metal parts used to be of relatively simple structure, not requiring machining.

Cost of the plough to be as low as possible without affecting quality.

An animal drawn plough needs to be light and suitable for carrying over the shoulder, because the farmer often has to carry the plough considerable distances along narrow paths or bunds to the field to be ploughed. The Kedah and Malacca ploughs weigh 39 lb. and 34 lb. respectively against the weights of the Japanese ploughs which vary from 29 lb. to 47 lb. The heavier types of Japanese ploughs incorporate a number of metallic structures, such as a reversible ploughing attachment and a mechanism for increasing or decreasing the throw of the plough. These structures can be dispensed with. The reversible mechanism is not of great importance, since the Malayan buffalo cannot make a complete turn at the headland, while the throw of the plough can be adjusted to some extent by merely rolling the plough to the right or to the left. The Japanese ploughs also make use of bolts, nuts and machined parts. These, besides adding to the cost of the manufacture, are situated in a position where they are in contact with the soil and therefore susceptible to corrosion.

The cost of the local Malacca plough is $50. Against this, the Japanese ploughs vary in price from $56 to $61. By removing unnecessary parts in the ploughs and simplifying construction, it is possible to reduce the cost of the latter.

A number of trials were carried out with imported and local ploughs which are summarised at Appendix I.

Development

Plough design based on the conventional European mould board plough proved to be heavier in drought than either the Japanese or the Malacca ploughs. This was presumably due to the suction taking place between the flat bottom of the share and the wet soil. The main defect however, was crabbing towards the land. It should be possible to prevent crabbing by giving the plough a long landside of perhaps by making use of some form of furrow wheels, as in mounted ploughs, but it was thought that these modifications would not prove satisfactory.

Two ploughs were made for development work. The first plough had a share point at the side, a mouldboard which would give a backward thrust of the furrow slice and no landside. (Plate 2) This was to see if crabbing was really due to the side share point and whether this crabbing could be eliminated by making use of a different type of mouldboard. The result showed that the crabbing could be eliminated to a certain extent and then only at the expense of inversion.

The second plough was given a centre point share, a mouldboard similar to that of the first plough and no landside. (Plate 3) The share point was made broader and was given a better suction. This plough performed well both with regard to penetration and inversion, while the draught compared favourably with the best of the ploughs tested previously.

Coupled with the design of the plough share and mouldboard was the simplification of the attachment of the plough to the wooden frame. Plate 4 shows the result achieved.

The wooden bodies of the Japanese ploughs were of less elaborate design than the Malayan ploughs and were made of straight pieces of wood with steel reinforcement at the angles. (Plate 5) The depth control mechanism consisted merely of a hitch with a series of holes for the different depths required. For local conditions it was found that the hitch was too high, resulting in the plough penetrating too deep. An extension to allow for lower hitch points had to be fixed (see Plate 7(a)).

In order to dispense with the use of the extension for the hitch, lowering the beam of the plough body was tried; even with this modification the extension still had to be used. Further, the furrow slice, on moving up the mouldboard, tended to get caught in the angle of the plough body. Lowering the hitch point by decreasing the angle of the plough body achieved the desired object, viz., elimination of the need for the extension.

A number of trials were carried out with other modified ploughs and they are summarised in Appendix II and III.

Discussion

From the results of the various trials it was possible to produce the prototype of the 'ideal' plough. The design for this prototype included the following points:—

(a) *A six and a half inch plough with replacement share*

The share was not heat treated for hardening, as it was thought to be unnecessary in view of the fact that a plough share made of mild steel could last a number of years.

(b) *The elimination of excess weight*

This was achieved by reducing excess metal fittings and by using a light but hard wood.

(c) *A light but hard wood for the body of the plough*

Only a limited number of suitable types of wood are available. These are the Red Meranti, (*Shorea pauciflora*, etc.) Seraya (*Shorea curtisii*) and the Malayan Teak (*Vitex pubescens*). The latter was found to be most suitable and is in fact largely used in local ploughs. A further point in favour of this wood, in addition to its durability, is that the trees are easily obtainable from areas around the villages.

As a result it was possible to reduce the weight of the prototype to 25 lb. compared with the lightest of the Japanese ploughs, at 29 lb.

The cost of the plough was kept down to the absolute minimum by adopting the following economies:—

The simplification of the structure of the plough, resulting in less time required for assembly, and

The use of ready made mild steel plate and iron rods.

By this means, the cost of manufacturing the plough was reduced to between $30—$35.

The prototype of the 'ideal' plough was tested in Malacca, in the presence of a number of padi planters. It gave a good performance with regard to penetration and inversion. The draught was found to be appreciably less than that of the Japanese 6″ plough. Working in coastal clay soil draught was 200 lb., against 300 lb. for the Japanese plough, while working at a depth of six inches.

APPENDIX I

Trials of Imported, Local and Modified Ploughs.

Locality: Pulau Gadong, Malacca. Type of Soil: Gelam Soil.

Type of Plough	Width of furrow	Depth of furrow	Draught (lb.)		Inversion of furrow	Area Ploughed (ft)	Time of Ploughing	Remarks
			Max.	Min.				
	(in)	(in)						
Matsuyama 6"	10	6	340	180	Good	10 x 210	1 hr. 10 min.	Plough tended to penetrate too deep, extension at hitch point used.
Malacca Plough	10	5	350	140	Good	10 x 210	40 min.	The plough was heavy for carrying but easy to handle while ploughing.
Locality: Pokok Mangga Road.							Type of Soil: Coastal Clay.	
Matsuyama 8"	9	6	—	—	Good	70 x 10	28 min.	Draught not taken. Did not appear to be heavy.
Matsuyama 6"	8	6	—	—	Good	90 x 10	25 min.	- do -
Model F.	8	6	400	120	Poor	90 x 10	30 min.	Crabbing.
Model H.	8	4½	300	120	Poor	90 x 10	30 min.	- do -
Model M.	8	4—5	—	—	Fair	90 x 10	34 min.	Draught not taken.
Ploughs designed at Workshop and Pool with side share points and landsides.								
Modified plough with Malacca body	10	3	360	150	Fair	10 x 210	45 min.	This was a repetition of a furrow test by Mr. Haynes.
Model K.	6½	4½	300	130	Poor	10 x 210	1 hr. 15 min.	Crabbing of plough; furrow slice tended to overshoot top of mouldboard.
Model H.	7	5	350	180	Poor	10 x 210	55 min.	- do -
Model F.	8	5	350	200	Fair	10 x 210	45 min.	- do -
Model Y.	8	5	450	250	Fair	10 x 210	45 min.	This plough had its beam lowered. Clogging of angle of beam occurred. The draught was heavy.
Model T.	6	4	400	240	Poor		60 min.	
Model M.	8	5	600	250				Draught too heavy.

Appendix II

Trials of Modified Ploughs at Negri Sembilan.

Locality: Kuala Kelawang, Negri Sembilan. Type of Soil: Clay soil with subsoil at 4—5″ depth.

Type of Plough	Depth of Furrow	Width of Furrow	Draught (lb.)		Furrow Inversion	Area Ploughed (ft)	Time of Ploughing (min.)	Remarks
			Max.	Min.				
	(in)	(in)						
* Model I 6½″ mouldboard with side share point but no land side.	4	7½	300	100	Fair	63 x 10	27	Slight crabbing observed. Part of furrow slice tended to fall on the opposite side as well.
* Model I 6½″ mouldboard with centre share point and no land side.	4	7	300	100	Good	63 x 10	27	No crabbing observed. Penetration better than the Japanese ploughs in that it did not tend to ride on the share points as in the latter.
Matsuyama 6″	4—5	7	300	130	Good	14 x 35	18	For comparison with the other two ploughs.

Note: Both modified ploughs Model I and each used a plough body with lowered hitch obtained by decreasing the angle of the beam of the body as in Plate 7.

Appendix III

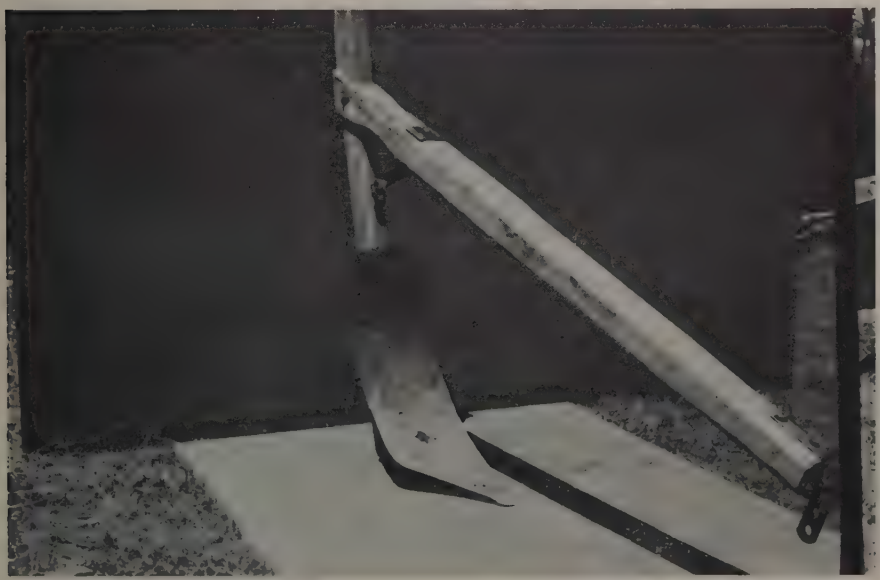
Pulau Gadong Padi Experiment Station, Malacca.

Type of Plough and Soil	Width of Furrow	Depth of Furrow	Draught (lb.)		Turning of Furrow	Area Ploughing (ft)	Ploughed Time of (min.)	Remarks
			Max.	Min.				
	(in)	(in)						
Coastal Clay								
Matsuyama 6"	9	6	300	150	Good	15 x 150	68	
Malacca	11	7	310	160	Good	15 x 150	71	
Plough Modified I	9	6	200	150	Good	15 x 150	72	
" " II	9	6	250	130	Good	15 x 150	64	
" " III	9	6	—	—	Poor	15 x 150		Poor inversion. Test abandoned.
Gelam								
Matsuyama 6"	9	6	280	130	Good	215 x 20	102	
Malacca	10	6	300	140	Good	215 x 20	100	
Modified plough I	8	5	275	140	Good	215 x 20	89	
" " II	9	6	280	120	Good	215 x 20	84	
" " III	9	6	320	180	Poor	215 x 20	98	Unsatisfactory.

PLATE 1

The first three ploughs on the left were made at Workshop and Pool, Serdang. On the extreme right is the Malacca plough.

PLATE 2



Plough made at Workshop and Pool with side share point, backward mould-board and no landside.

PLATE 3

Workshop and Pool made plough with centre point share.

PLATE 4

Simplification of attachment of plough to wooden frame, using manufactured mild steel plates and iron rods.

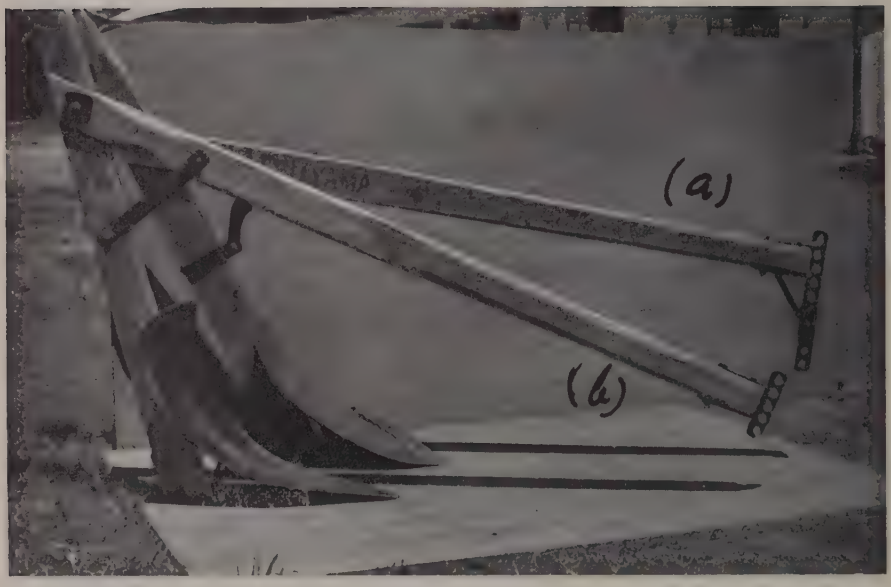
PLATE 5

Attachment of the Japanese plough to the plough body. Compare with Plate 4.

PLATE 6

The Japanese plough detached from the body. Note the machined shaft (x).

PLATE 7



Showing the greater angle of the beam of the Japanese plough (a) with the extension on the hitch; (b) shows the angle decreased and the absence of the extension.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

(October to December, 1959)

Weather

Weather conditions have been generally favourable in the padi growing areas, although a water shortage was experienced in the Tanjong Karang area of Selangor when nurseries were being sown. This setback for the padi seedlings resulted in late transplanting and uneven growth in the irrigation area.

Padi

Breeding and Selection

A comprehensive programme was successfully established in the field by the end of the year. Growth has been rather better than usual with no flood damage reported. Padi stem borer was severe at Pulau Gadong, Malacca, and at Bukit Merah, Province Wellesley.

Research into the production of improved varieties for off-season cropping has been intensified, and a number of promising non-photosensitive hybrid strains are being tested.

Pot Experiments

Pot experiments with padi conducted on the Byan Pyas soil from Telok Anson area and on the soil from the Soils/Water Research Station site, Tanjong Karang, have been completed. Analysis has been done on the plants harvested at the flowering stage. The results show that the virgin Byan Pyas soil is fertile and padi plants show little response to fertiliser. On the Tanjong Karang soil padi plants respond to nitrogen. Indications are that the soil is also low in calcium.

Pot experiments are being conducted on six Kelantan padi soils. Padi plants were transplanted into the pots in the last week of November. In all the soils the plants responded to the addition of super-phosphate to a marked degree. Addition of an initial dose of urea before transplanting has also given response in most of the soils.

Agronomic Investigations and Extension

In the seedling investigations which have been continued beyond the nursery stage, the following treatment effects have remained evident since transplanting.

(i) Plants which received ammonium phosphate and farm yard manure in the nursery have maintained a leafier and greener appearance after transplanting than those plants which did not receive these treatments.

(ii) Nitrogen and phosphorus applied as straight chemical fertilisers in the nursery tend to produce straighter and stronger plants

in the field. Too much potash in the nursery appears to have the delayed effect of reducing tillering capacity.

(iii) An important experiment in progress compares continued effects of high or low standards of management in both the nursery and field. Preliminary observations show marked differences in the appearance of plants between treatments.

(iv) Growth differences between overage seedlings and those planted at the appropriate stage of development on one trial are very noticeable. Reduced yields are expected from overage seedlings and it should be feasible to record differences with accuracy.

Crop Report

WET PADI

Following the record area of 11,641 acres of off-season padi planted in 1959, by the end of the quarter a further all-time record of 868,895 acres of main season wet padi had been planted. This represents 98.8 per cent of the estimated acreage to be planted, and planting had not been completed in Trengganu, Selangor, Pahang, Negri Sembilan and Johore.

The total area of 880,536 acres of wet padi planted in 1959 is 12,766 acres more than that planted in 1958. Whereas the West Coast States have maintained the *status quo*, the largest increases in acreages have occurred in the East Coast States. Major increases have occurred in Kelantan (1,723 acres), Trengganu (2,175 acres), Pahang (2,313 acres) and Johore (1,428 acres). In these States considerable emphasis has been placed on increasing padi acreages by the extension staff of the Department of Agriculture.

Indications throughout most of the country are that the main season padi crop will be above average. There are very few reports of damage by drought, flood and pests. The only major exception is in the Tanjong Karang Irrigation Area of Selangor where the growth of the crop is reported to be uneven owing to shortage of water at the time of sowing nurseries, late transplanting, severe rat damage and insect damage.

At the end of the quarter harvesting was in full swing in Perlis, Kedah and Pahang and had commenced in Penang, Perak, Malacca and Johore. Initial yields were very good.

DRY PADI

At the end of the quarter 33,614 acres of lowland dry padi and 27,586 acres of upland dry padi had been planted. There is little change in the acreage of lowland dry padi from the previous season, but the acreage of upland dry padi has increased by 4,936 acres or nearly 22 per cent. As with wet padi, crop prospects are good.

Rubber

Distribution of rubber planting material to smallholders for new planting and replanting amounted to 113,592 yards of budwood and 6,685,781 clonal seedling stumps. Distribution in the same quarter of 1958 amounted to 86,281 yards of budwood and 5,933,959 clonal seedling stumps.

Coconut

There was a slight increase in the price of copra during the quarter, with good quality copra realising $39 to $43 per pikul. Response by smallholders to the loan facilities for land improvement offered by the Planters' Loans Board for coconuts and other crops continues to be good, particularly in the coastal areas of Selangor and Perak. At the Federal Experiment Station, Telok Bahru, a further 290 seed coconuts were received from the Senior Botanist and Sungei Bernam Estate; 1,285 seedlings were transplanted into the field but 301 of these represented replacements. Weed control and beetle control form a large part of the maintenance work on this station.

Experiments on insecticidal control of *Oryctes rhinoceros* were started in Telok Bharu in April 1959, using BHC, Basudin, Dieldrex Extra, Endrin, Naphthalene and paradichlorobenzene. Monthly records of *Oryctes* attack taken since the start of the experiment and up to November 1959, show insignificant differences in pest attack between treatments. The percentage of attack in all the treatments, including that of control, remained below 10 per cent the whole time, except for paradichlorobenzene plots, where it rose slightly over 10 per cent in August and September only.

The above results suggest that the treatments have no control over *Oryctes*.

Coffee

In November an outbreak of the clear wing hawk moth, *Cephonodes hylas* L., in the Kuala Langat district, Selangor, was reported. The outbreak had apparently first appeared in May but was neglected, and by November approximately 370 out of the 400 acres of coffee holdings in the Bukit Cheeding locality were affected, with severe defoliation of bushes on an estimated 50—100 acres. Fogging and spraying tests were undertaken by the Department and DDT and BHC formulations were both found to be effective as control measures. 400 lb. of insecticide were supplied to smallholders for spraying the worst affected areas, and supplementary fogging has been undertaken when caterpillars were in the early stages of development. The pest outbreak is confined to the Bukit Cheeding coffee area at prsent. It may be recalled that it was this moth which caused such extensive damage to coffee in Selangor some 50 years ago.

The average dealers' price for dried Liberian coffee beans at Klang, the trade centre of the major coffee-growing areas of Malaya, was

maintained at between $140 and $150 per pikul during the quarter. Growers obtained an average of about $3.50 per four gallon tin of freshly harvested berries.

Fruit

Citrus rootstocks produced at Serdang for trials at the Federal Experiment Stations, Telok Bharu and Gajah Mati, exhibit considerable differences in vigour of growth. Pomelo and rough lemon seedlings at seven months old are ready for budgrafting but the other seven varieties are ready later at varying lengths of time. *Poncirus trifoliata* is particularly slow in its development. This is disappointing as this rootstock is considered to be resistant to collar rot and gummosis.

There was an excellent crop of pomeloes in the Kinta district of Perak and a good crop of *limau nipis* in Negeri Sembilan. The harvest of Mandarin oranges, particularly in Lower Perak, was light.

The rambutan clonal trial at Serdang was harvested during the quarter but the yield was poor. It has been an unfortunate season over much of the country and similar poor yields were obtained from observation plots at Jalan Kebun. The durian and mango harvests have also been very poor this season.

Distribution of fruit planting material to smallholders during the quarter was as follows:—

	Rambutan	Durian	Citrus	Chempedak	Chiku	Kwini	Others	Total
Perlis	—	—	271 (M)	—	—	—	—	271
Kedah	554	77	13 (M)	—	8 (M)	—	—	652
Penang	663	161	121 (M)	—	—	—	1 (M)	946
Perak	3,496	67	—	—	—	—	25	3,588
Selangor	2,251	259	37	—	11	—	169	2,727
N. Sembilan	696	80	52	—	2	—	17	847
Malacca	823	—	4	—	—	—	2	829
Johore	—	—	—	—	—	—	—	—
Pahang	925	35	136 (M)	27	31 (M)	41	43 3 (M)	1,241
Trengganu	64	312	—	27	—	—	8	411
Kelantan	—	—	—	—	—	—	—	—
Total	9,472	991	634	54	52	41	268	11,512

M = marcotted.

Tea

Steam sterilisation of soil for propagation beds at the Federal Experiment Station, Cameron Highlands, has resulted in an improvement in rooting percentage obtained from tea cuttings.

Selected varieties in the clonal collection are being eyescored for apparent resistance to blister blight. It is intended that highly resistant varieties should be used for preliminary yield tests.

Tea established at the Federal Experiment Station, Jerangau, Trengganu, continues to grow very well. Similar test plots on deep peat soil at the Federal Experiment Station, Jalan Kebun, are less satisfactory but further investigation may lead to improved results on this type of soil.

Cocoa

Die-back is so bad in the Indonesian Trinitario area at Serdang that yield recording has been discontinued.

An outbreak of black-pod disease (*Phytophthora palmivora*), not previously recorded on cacao in Malaya, was controlled by intensive fungicidal spraying and field hygiene.

Cacao die-back at the Federal Experiment Station, Jerangau, was not as prevalent as might be expected in view of the heavy monsoon. Foliar nutrient sprays seem to have improved leaf colour on treated trees. In spite of die-back, a reasonable crop is expected next quarter.

Further investigation with herbicides has shown that sodium chlorate, the most satisfactory, has no harmful effect when applied at 20 lb. per acre but does cause mild scorch to cacao at double this rate of application. Mulching seems to be improving the growth of cacao but has had no effect on the incidence of die-back.

Pastures and Fodders

Brachiaria brizantha continues to prove itself a promising pasture grass at the Federal Experiment Station, Serdang. It has remained the dominant species after continuous grazing and mowing.

A number of varieties of lucerne (*Medicago sativa*) are under test in various areas. Growth is invariably poor and has deteriorated even further during the wet season.

Soil Survey

Initial examination of all State Land Development Schemes and Rubber New Planting Schemes is now carried out by State A.A.'s, trained in soil survey methods. Soil samples from representative profile pits are sent to Soils Division for examination and confirmation of the A.A.'s findings. Doubtful areas are visited by Soils Division personnel who decide whether a certificate of suitability should, or should not, be issued for the area. This system of inspection has proved satisfactory for the smaller proposed development areas and has considerably reduced the amount of *ad hoc* survey work carried out by Soils Division. How-

ever, towards the end of the year, a number of rather larger areas (up to 3,000 acres) were inspected by State A.A.s and some of these proved to be of distinctly marginal suitability and required further inspection by soils experts from the R.R.I. as well as from the Department of Agriculture.

Pineapple

The Canning Research Station, Johore was placed on a care and maintenance basis. Permission was given to the Pineapple Inspectorate to use the facilities of the Station for training purposes.

Agricultural Education at Rural Level

Rural Agricultural Training Centres were in operation in all States during the quarter. The following are the number of courses and the number of trainees attending these courses by States:—

State	*No. of Courses*	
Perlis	1	12
Kedah	4	44
Penang	2	4 Army pers.
		32 female
Perak	3	60
		10 Army pers.
Selangor	4	53
N. Sembilan	2	38
		6 Army pers.
Malacca	3	42
		6 Army pers.
Pahang	2	26
		5 Army pers.
Trengganu	5	60
	26	398

In Pahang a second Training Centre has been completed at Temerloh, the original centre being at Pekan. The new centre is expected to be opened for its first training course early in 1960.

Farmers' Associations

The services of a 4-H club expert from the Philippines were made available during the quarter through a generous offer from the Asia Foundation. Mr. del Rosario, the expert, arrived in Malaya in October, 1959, and has been attached to the Department. The main purpose of Mr. del Rosario's work is the organization of Farmers' Associations for promoting agricultural improvement. This has been pursued through the training of field staff of the Department in agricultural extension followed by actual organization of Farmers' Associations by the trained officers, under the guidance of Mr. del Rosario.

STAFF NOTES

(Period 1st October to 31st December, 1959)

Honours and Awards

Che Othman bin Mohd. Lela, Agricultural Development Officer, was awarded the Kedah Distinguished Service Medal by His Highness the Sultan of Kedah on 28th November, 1959.

Promotions

Name	*Promoted to*	*Date w.e.f.*
A. L. Barcroft, Assistant Director (Field)	Deputy Director of Agriculture	12. 6.59
G. S. Keeping, Senior Agricultural Officer, Grade 'A'	Assistant Director (Field)	12. 6.59
A. V. Haddon, Botanist (Timescale)	Senior Research Officer, Grade 'A'	25. 6.59
Othman bin Mohd. Lela Agricultural Assistant (Special Grade)	Agricultural Development Officer	23. 8.59

Appointments

Name	*Appointment*	*w.e.f.*
Mohd. Noor bin Wahab, State Agricultural Officer, Perlis.	State Agricultural Officer, Malacca.	1.11.59
Chee Sek Pan, Agricultural Officer.	Agronomist	25.11.59
Ahmad bin Baba, Agricultural Officer.	Senior Lecturer, College of Agriculture.	7.12.59

Leave

Name		*w.e.f.*
Ting Wen Poh, Plant Pathologist.	On study leave	5.12.59
G. I. M. Martin, Agronomist.	On long leave	13.12.59

Retirements

The following officer proceeded on leave prior to retirement under the Tenth Schedule to the Federation of Malaya Agreement (Amendment No. 4) Ordinance, 1956.

Name	*w.e.f.*
A. Cumming, Agricultural Development Officer.	5.11.59

July to September, 1959

Rubber.—The rubber price was very satisfactory during the quarter, averaging well above the dollar level. The average price in cents per pound f.o.b., as quoted by the Singapore Chamber of Commerce Rubber Association was as follows:—International Type I (R.S.S. 1) July 98.08, August 107.57, September 105.40.

The steady rise in production over the last three years is reflected in Table II. The production for estates in 1957 was 369,073 tons; for 1958, 390,200 tons and for 1959, 407,700 tons, an increase of approximately 38,000 tons over 1957. Total production, including smallholders, improved from 637,097 in 1957 to 696,100 in 1959, an increase of nearly 60,000 tons.

Palm Oil and Kernels.—The total production of palm oil in 1959 was about 2,000 tons better than in the previous year, but the price fell during the last quarter after reaching the year's highest monthly average of £83.7.0 per ton f.o.b. in August.

Coconuts and Copra.—Estate production was slightly lower than in 1958, but the price has been reasonably good and fairly steady throughout the year. Figures for smallholding production are only a very rough calculation and the apparent rise in production in Table VI of 14,000 tons over the 1957 total should be disregarded.

Table I

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, JULY TO SEPTEMBER, 1959

(dollars per pikul*)

Grades	Alor Star, Kedah			Negri Sembilan Seremban,			Johore Bahru, Johore		
	July	Aug.	Sept.	July	Aug.	Sept.	July	Aug.	Sept.
Smoked Sheet No. 1	109.09	118.40	116.06	109.38	117.37	114.27	109.75	117.81	114.07
Smoked Sheet No. 3	106.56	115.41	111.17	107.52	114.26	110.88	108.25	115.15	111.21

* 1 pikul = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION

FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1958	1959	1958	1959	1958	1959
January -	35,800	37,600	25,400	27,200	61,200	64,800
February -	28,800	27,900	22,900	21,200	51,700	49,100
March -	28,400	28,500	20,300	21,100	48,700	49,600
April -	26,600	28,800	18,200	19,300	44,800	48,100
May -	27,200	33,500	18,100	22,300	45,300	55,800
June -	31,200	33,800	21,800	24,200	53,000	58,000
July -	36,500	35,600	23,700	26,700	60,200	62,300
August -	34,000	36,400	24,600	24,700	58,600	61,100
September -	33,700	35,600	23,500	25,900	57,200	61,500
October -	35,000	35,900	23,000	25,300	58,500	61,200
November -	32,000	35,600	20,000	23,900	52,000	59,500
December -	41,000	38,500	30,000	26,600	71,000	65,000
Total -	390,200	407,700	271,500	288,400	661,300	696,100
Total 1957 -	369,073		268,024		637,097	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan		Ceylon		Indonesian		India				African	
							Northern		Southern			
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
2-10-59	3	11.69	6	1.76	Nil		6	1.58	3	7.24	3	3.26
9-10-59	4	11.57	6	1.16	Nil		6	0.20	3	7.54	3	6.02
16-10-59	4	5.08	6	1.04	2	11.75	5	7.77	3	8.25	3	4.06
23-10-59	4	2.42	6	0.29	Nil		5	5.23	3	9.28	3	4.15
30-10-59	4	5.73	5	11.65	5	0.75	5	4.44	3	10.97	3	3.94
6-11-59	6	0.25	5	9.98	Nil		5	3.28	4	0.78	3	0.61
13-11-59	4	6.78	5	6.24	Nil		5	0.91	4	2.79	4	1.49
20-11-59	4	4.46	5	2.64	3	11.50	4	10.76	4	3.30	3	11.46
27-11-59	5	5.50	5	2.72	Nil		4	10.08	4	3.45	4	0.81
4-12-19	4	8.24	5	0.48	4	2.41	4	9.68	4	3.48	4	3.12
11-12-59	4	11.79	4	10.94	3	4.75	4	9.30	4	3.83	4	4.67
18-12-59	4	5.76	4	10.65	Nil		4	9.29	4	4.55	4	6.63

Table IV

AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*

(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
3-10-59	160.00	158.00
10-10-59	160.00	155.00
17-10-59	155.00	150.00
24-10-59	150.00	150.00
31-10-59	150.00	150.00
7-11-59	150.00	145.00
14-11-59	145.00	145.00
21-11-59	145.00	145.00
28-11-59	145.00	145.00
5-12-59	145.00	145.00
12-12-59	140.00	140.00
19-12-59	140.00	140.00
28-12-59	145.00	140.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.

† 1 pikul = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL

(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil *		
	1958	1959	1958	1959	1959		
					£	s.	d.
January -	3,581	5,225	981	1,388	72	7	9
February -	4,460	4,824	1,192	1,356	73	13	6
March -	6,090	6,553	1,645	1,815	74	5	8
April -	5,748	5,268	1,552	1,404	75	1	9
May -	5,609	5,055	1,408	1,314	77	14	10
June -	5,782	5,931	1,398	1,565	78	11	5
July -	7,243	6,912	1,874	1,888	81	2	5
August -	6,939	7,005	1,832	1,958	83	7	0
September -	6,952	6,674	1,800	1,754	82	5	6
October -	5,825	5,031	1,523	1,536	74	11	0
November -	5,517	6,145	1,452	1,682	74	2	4
December -	5,925	6,018	1,616	1,634	74	8	9
Total -	69,671	71,541	18,273	19,294			

* F.O.B.

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE
FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1958	1959	1958	1959	1958	1959	1958	1959	1958	1959
January	2,449	1,827	1,857	8,000	4,306	9,827	8,164	4,195	5,136	2,709
February	2,546	1,947	8,100	1,500	10,646	3,447	5,458	3,556	3,397	2,298
March	2,895	2,377	7,028	6,000	9,923	8,337	7,032	4,027	4,469	2,643
April	2,910	2,523	8,421	6,000	11,331	8,523	6,032	4,636	3,905	3,041
May	3,275	3,097	11,123	8,000	14,398	11,097	7,223	5,327	4,690	3,519
June	3,431	3,338	3,447	13,000	6,878	16,338	7,485	8,385	4,886	5,499
July	3,985	3,779	8,572	9,000	12,557	12,779	7,828	5,880	5,183	3,964
August	3,575	3,445	9,200	9,000	12,775	12,445	7,168	7,343	4,669	4,734
September	2,769	3,122	5,400	8,700	8,169	11,822	7,168	6,136	4,620	3,819
October	2,519	2,622	6,000	9,000	8,519	11,622	6,939	5,608	4,472	3,570
November	2,134	2,321	4,000	7,000	6,134	9,321	4,351	5,739	2,805	3,693
December	2,332	2,681	4,000	6,000	6,332	8,681	3,703	6,340	2,442	3,999
Total	34,820	33,079	77,148	91,200	111,968	124,239	78.551	67,162	50,674	43,488

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS

(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil *	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
12-10-59	43.75	67.00	165.00	175.00	46.00	8.62	18.00	16.00
19-10-59	43.75	67.00	165.00	175.00	46.00	8.62	18.00	15.00
26-10-59	43.00	67.00	173.00	183.00	46.00	8.62	18.00	15.00
16-11-59	39.00	67.00	188.00	182.00	45.00	8.50	18.00	15.00
23-11-59	38.00	61.00	266.00	276.00	46.00	8.62	18.00	16.50
30-11-59	30.00	61.00	176.00	186.00	46.00	8.62	18.00	16.25
14-12-59	40.75	62.00	246.00	256.00	46.00	8.62	18.00	16.50
21-12-59	39.75	63.00	271.00	281.00	46.00	8.65	17.00	16.50
28-12-59	39.75	63.00	311.00	321.00	45.00	8.62	17.00	18.00

† 1 pikul = 133⅓ lb.

* F.O.B. in second-hand drums.

‡ Nominal.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS, JANUARY TO DECEMBER, 1958. ‡

Product	Net Exports in Tons			
	Year 1955	Year 1956	Year 1957	Year 1958
Arecanuts	13,679	11,228	9,625	4,938
Coconuts, fresh †	72,140	34,779	37,466	52,340
Coconut oil	91,176	103,132	100,031	67,483
Copra	75,076 *	82,549 *	71,718 *	55,906 *
Copra cake	56,404 *	66,174 *	73,208 *	72,453 *
Gambier, all kinds	66	96	209	555
Palm Oil	52,832	55,252	56,728	67,818
Pineapples, canned	27,756	30,377	37,671	41,417
Sago, flour	23,053	21,483	15,581	21,652
Sago, pearl	5,483	4,276	4,021	3,104
Sago, raw	18,709 *	18,522 *	14,006 *	13,383 *
Tapioca, flake	475	260	403	350
Tapioca, flour	3,979 *	3,753 *	1,573 *	1,920 *
Tapioca, pearl	5,470	5,630	5,222	3,333

† hundreds. * net imports.

‡ Statistics compiled from "External Trade of Malaya" (Colony of Singapore and Federation of Malaya) December, 1958.

METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall							Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 4 foot	At 1 feet	Total	Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F		Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.					hr.	hr.	
Ipoh, Perak	71.2	72.2	81.9	94.0	70.0	84.0	74.8			5.56	141.2	1.45	14	10	4			193.30	6.25	
Kuala Lumpur, Selangor	88.8	73.3	81.5	92.2	71.4	84.0	75.1			5.47	138.9	1.81	13	12	7		2	188.45	6.08	
Sitiawan, Perak	88.4	72.5	80.5	90.8	70.4	82.9	75.1	84.2	85.2	2.82	71.6	1.24	12	10	2	1		198.65	6.41	
Kuantan, Pahang	88.5	72.1	80.3	91.2	66.6	81.9	75.0	83.1		5.39	136.9	1.90	14	10	12	2	1	180.80	8.83	
Bayan Lepas, Penang	89.5	73.9	80.7	90.0	70.6	81.5	76.1			9.21	233.9	1.37	16	13	8		1	185.00	5.97	
Malacca	86.1	72.7	79.4	88.3	70.0	81.6	74.9			9.46	240.3	2.20	18	16	10	1		187.10	6.03	
Mersing, Johore	85.4	71.0	78.2	89.4	66.4	77.9	73.6			8.71	221.2	2.08	17	15	7		2	171.80	5.54	
Alor Star, Kedah	87.8	73.6	80.7	91.0	71.3	79.6	76.4			9.68	245.9	1.31	19	16	4			188.85	6.09	
Kota Bharu, Kelantan	88.3	74.0	81.1	91.5	71.0	83.8	77.0	85.0	86.2	8.65	219.7	1.62	16	15	13		1	223.45	7.21	
K. Trengganu, Trengganu	88.2	73.5	80.9	90.0	69.3	85.6	75.5			4.61	117.1	1.27	11	8	8			212.40	6.85	
Singapore	86.3	74.3	80.3	89.1	71.8	78.1	78.2			7.81	198.4	2.93	14	11	9			161.90	5.22	
HILL STATIONS																				
Cameron Highlands, Tanah Rata, Pahang. (3750 ft.)	72.3	55.8	64.1	76.2	48.0	66.0	61.0			8.45	214.6	2.07	18	16				143.25	4.62	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of Days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet	Total		Most in a day	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
												Amt.								
								o F	o F	in.	mm.	in.						hr.	hr.	
Ipoh, Perak	91.4	72.9	82.1	94.8	68.8	84.8	75.0			12.26	311.4	1.50	20	18	9			192.80	6.43	
Kuala Lumpur, Selangor	89.8	73.4	81.6	94.9	71.1	82.2	75.7			13.18	334.8	3.02	20	15	13	1		190.50	6.35	
Sitiawan, Perak	88.7	22.4	80.5	91.6	69.6	82.8	75.7	84.1	85.2	6.65	168.9	2.06	16	12	2	2		181.85	6.06	
Kuantan, Pahang	89.7	71.1	80.7	91.6	69.1	81.0	74.3	83.6		12.68	322.1	3.92	15	13	12	7		215.85	7.19	
Bayan Lepas, Penang	87.6	73.7	80.7	91.0	71.2	79.9	77.0			9.39	238.5	4.33	12	12	10			194.30	6.48	
Malacca	86.9	72.9	79.9	89.7	70.9	81.1	75.5			4.42	112.3	1.67	10	9	5			190.05	6.33	
Mersing, Johore	86.8	71.3	79.1	90.1	69.2	82.6	73.9			3.14	79.8	0.55	14	12	9			197.40	6.58	
Alor Star, Kedah	87.9	73.8	80.9	91.6	71.1	81.4	76.6			8.73	226.7	4.60	17	14	3			202.00	6.73	
Kota Bharu, Kelantan	88.2	74.1	81.1	90.2	72.1	86.6	75.9	86.1	86.6	5.56	141.2	2.06	11	10	5			226.75	7.56	
K. Trengganu, Trengganu	88.5	73.2	80.9	90.1	71.2	87.1	75.2			5.53	140.5	1.38	9	9	8			240.50	8.02	
Singapore	87.6	74.2	80.9	90.2	71.2	82.0	76.5			4.36	110.7	1.52	10	8	8			182.50	6.08	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.3	56.3	64.3	77.4	51.0	68.0	60.6			8.74	222.0	1.37	21	17				130.50	4.35	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1959

Locality	Absolute Extremes							Earth Temperature		Rainfall								Bright Sunshine		
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
													Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
	o F							o F		in.	mm.	in.						hr.	hr.	
Ipoh, Perak	91.0	73.2	82.1	94.2	70.0	83.9	75.4			10.05	255.3	2.28	22	18	7			173.15	5.59	
Kuala Lumpur, Selangor	90.1	73.9	82.0	92.4	71.4	83.8	76.3			15.34	389.6	2.01	21	19	19	5		190.45	6.14	
Sitiawan, Perak	88.3	72.9	80.6	91.7	71.0	83.9	75.0	84.3	85.3	14.21	360.9	7.00	20	17	9	3		169.40	5.46	
Kuantan, Pahang	88.0	72.8	80.4	91.6	69.0	83.0	75.0	83.4	85.3	8.34	211.8	1.62	23	17	11	8		168.95	5.45	
Bayan Lepas, Penang	87.2	74.1	80.7	89.8	71.4	84.8	76.0			13.27	347.1	2.69	21	19	14			172.05	5.55	
Malacca	87.4	73.2	80.3	90.8	71.2	82.5	75.7			8.12	206.2	1.97	19	16	7			189.30	6.11	
Mersing, Johore	87.0	71.3	79.1	92.4	68.2	80.9	74.0			10.03	245.8	2.76	15	15	6		2	207.25	6.69	
Alor Star, Kedah	88.2	73.5	80.9	91.4	71.8	82.2	75.4			12.08	306.8	2.42	23	20	7	1		170.30	5.40	
Kota Bharu, Kelantan	85.1	74.1	79.6	90.0	71.9	79.2	76.0	83.4		17.41	442.2	3.23	23	20	7	4		142.55	4.60	
K. Trengganu, Trengganu	85.5	73.5	79.5	89.0	70.0	80.2	75.1			9.40	238.8	2.17	18	18	2	1		166.60	5.37	
Singapore	88.4	74.2	81.3	91.0	71.1	81.1	77.0			6.37	161.8	1.95	12	10	10			176.95	5.71	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.8	57.9	65.3	76.0	51.2	68.6	62.8			19.10	485.1	2.66	24	21				124.15	4.00	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	90.1	72.9	81.5	93.8	71.0	84.8	75.0			12.11	307.6	3.52	21	20	4			160.75	5.36	
Kuala Lumpur, Selangor	88.9	74.0	81.5	91.7	72.1	81.2	75.5			11.51	292.4	2.33	21	17	7	6		158.20	5.27	
Sitiawan, Perak	87.2	73.3	80.3	90.8	71.2	81.8	74.9	81.9	82.5	12.17	309.1	2.21	24	20	7	1		162.40	5.41	
Kuantan, Pahang	86.2	72.5	79.3	91.8	70.2	77.4	74.5	82.4		10.78	273.8	1.88	27	21	12	1		124.60	4.15	
Bayan Lepas, Penang	86.6	73.4	80.0	90.4	70.0	81.9	76.5			9.11	231.4	2.55	20	12	9			160.50	53.5	
Malacca	87.2	73.3	80.3	89.2	71.8	84.1	75.0			6.26	159.0	0.87	20	17	8			137.40	4.50	
Mersing, Johore	84.7	71.7	78.2	90.4	69.7	79.2	74.0			12.74	232.6	2.72	25	22	4			118.55	3.95	
Alor Star, Kedah	87.0	72.9	79.9	93.7	70.7	76.6	74.8			12.31	312.7	2.32	18	16	8	2		171.95	5.73	
Kota Bharu, Kelantan	83.8	74.1	78.9	87.3	71.9	76.8	78.2	81.1	81.8	51.45	1306.8	11.12	24	22	6	2	3	147.25	4.91	
K. Trengganu, Trengganu	83.1	73.5	78.3	87.1	71.0	76.3	75.7			54.62	1387.3	18.55	25	23	1			131.25	4.37	
Singapore	86.7	73.7	80.2	90.2	70.6	78.5	75.5			8.74	222.0	1.97	18	16	12			118.95	3.97	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.4	58.0	65.2	76.0	53.4	69.6	63.2			9.92	242.0	1.60	26	23				111.70	3.72	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, DECEMBER, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
				Absolute Extremes								Number of Days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	91.7	72.3	82.0	95.0	68.0	77.2	74.8			10.09	256.3	2.90	13	19	6			233.10	7.52	
Kuala Lumpur, Selangor	90.2	73.7	81.9	94.4	71.6	80.2	76.6			5.42	137.7	1.72	18	14	9	2		212.15	6.85	
Sitiawan, Perak	88.4	72.7	80.9	91.0	69.9	77.2	75.6	83.5	84.2	5.58	141.7	1.38	15	13	3	3		245.60	7.92	
Kuantan, Pahang	85.7	71.2	78.5	89.9	66.0	75.3	74.2	80.8		25.37	644.4	5.79	18	15	3	3		168.90	5.45	
Bayan Lepas, Penang	89.2	73.2	81.2	92.4	69.3	82.1	76.9			4.01	101.9	3.07	7	5	4			246.80	7.96	
Malacca	87.8	73.1	80.5	90.5	71.1	83.2	75.8			4.14	105.2	0.83	19	16	4			192.95	6.22	
Mersing, Johore	83.8	72.4	78.1	89.0	69.9	79.4	77.0			18.72	475.5	4.82	20	19	1			175.00	5.65	
Alor Star, Kedah	88.6	71.9	80.3	92.4	67.3	81.7	74.5			3.42	86.9	0.97	10	8	2	1		213.15	6.87	
Kota Bharu, Kelantan	83.8	74.1	78.9	86.6	70.4	76.6	79.2	79.7	79.3	15.35	389.9	3.75	15	14	1	2	1	191.00	6.16	
K. Trengganu, Trengganu	83.1	73.6	78.3	86.7	70.1	75.7	77.3			14.22	361.2	5.47	19	17	1	1		185.40	5.98	
Singapore	86.3	73.5	79.9	89.0	70.1	80.1	75.3			20.35	516.9	4.63	24	21	18			144.35	4.66	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.4	56.0	64.2	76.6	48.6	64.0	62.2			7.08	179.8	1.74	19	15				156.85	5.06	

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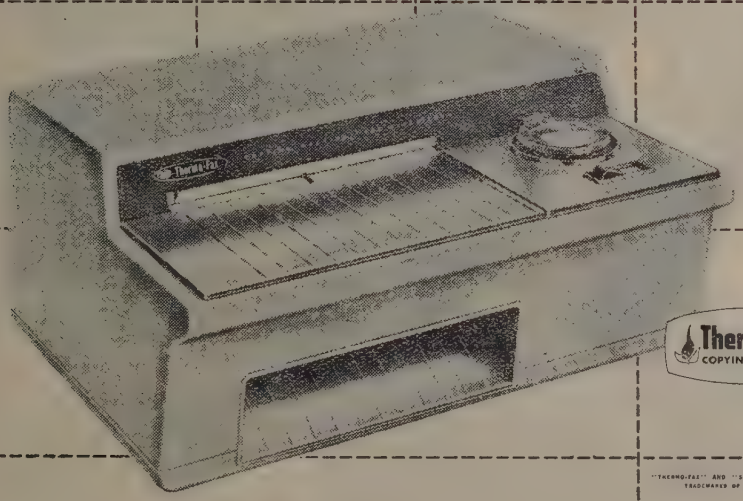

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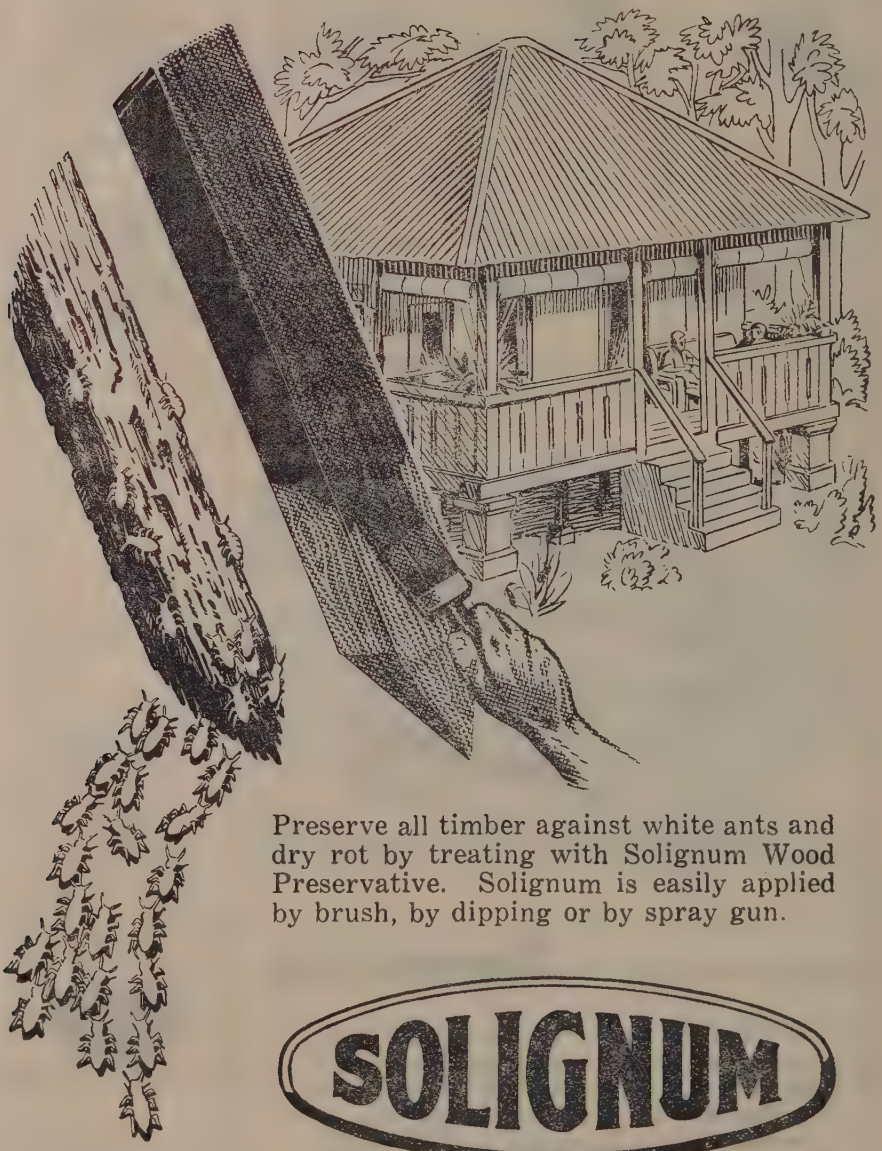

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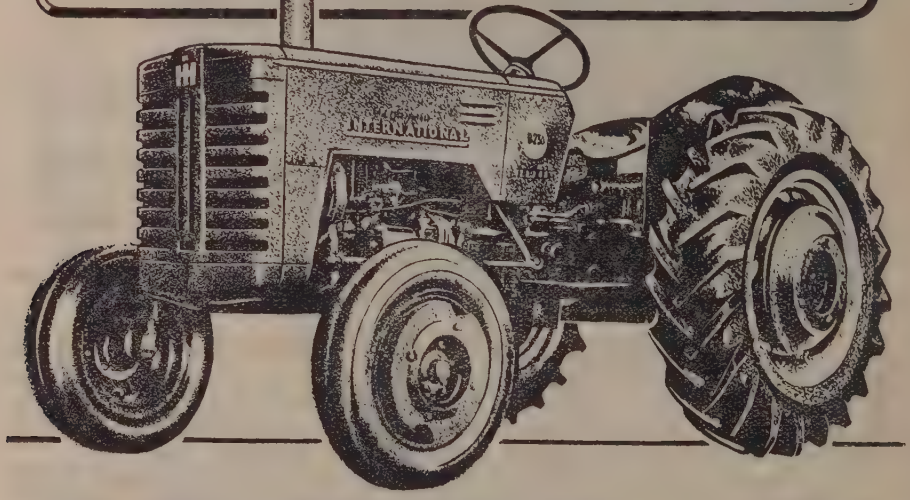

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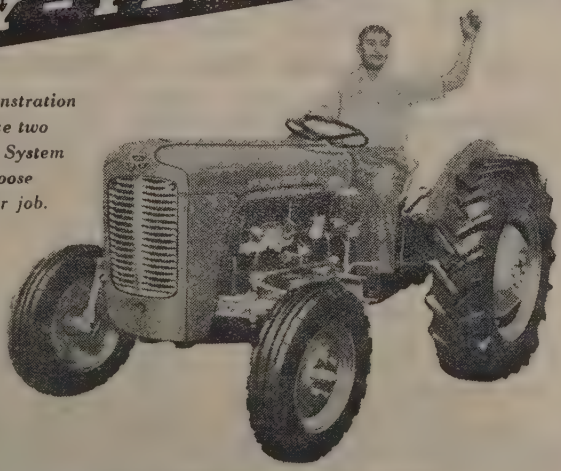

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Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State Agricultural Officer, concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

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Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor, and Jerangau, Trengganu.

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